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CANADIAN GEOGRAPHICAL JOURNAL

Editor - *Gordon M. Dallyn*

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This magazine is dedicated to the interpretation, in authentic and popular form, with extensive illustration, of geography in its widest sense, first of Canada, then of the rest of the British Commonwealth, and other parts of the world in which Canada has special interest.

Contents

OCTOBER, 1938 VOLUME XVII No. 4

COVER SUBJECT:—Following their "Conquest of Mount Lucania" in July, 1937, Bradford Washburn and Robert H. Bates (in foreground) hesitated on the summit of Mount Steele (16,600 feet), another Yukon giant, to admire and photograph a scene that recalls the following verse by Thomas Hood:

"Each cloud-capt mountain is a holy altar
An organ breathes in every grove;
And the full heart's a Psalter,
Rich in deep hymn of gratitude and love."

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The British standard of spelling is adopted substantially as used by the Dominion Government and taught in most Canadian schools, the precise authority being the Oxford Dictionary as edited in 1929.

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ABOVE:—South face of Mount Iliamna (approximately 10,200 feet). This volcano has not been conquered, and the surrounding territory is completely unexplored. Steam is seen rising out of the snowbank on right.

LEFT:—Halted at an altitude of 14,000 feet on the tremendous easterly ridge of Mount Steele. The route out to Burwash Landing wound around peaks in the background.

CONQUEST OF MOUNT LUCANIA

Recounted by **BRADFORD WASHBURN**

MOUNTAINEERING achievements have a material interest for the geographer, as they are frequently responsible for the removal of "blank" spots from maps of various sections of the earth's surface, and for the general public when accompanied by deeds of great daring. Pioneers of perseverance persist even today in the disclosure of geographical secrets that may ultimately reveal resources of much benefit to mankind, as indicated last April, when members of the Canadian Geographical Society in Ottawa listened with admiration to the account of one such expedition into the southwestern corner of the Yukon Territory.

The speaker, Mr. Bradford Washburn, is a young explorer of note and instructor

Main base on Walsh Glacier, where $1500 worth of survey instruments cameras, food and other equipment had to be abandoned, snow conditions preventing other members of the expedition from flying in. The tremendous ridge of Mount Logan rises in the distance, nearly forty miles away.

at the Institute of Geographical Exploration at Harvard University. His story was recounted with a delightful sense of humour, especially in the presentation of the perils experienced by himself and Mr. Robert H. Bates in their conquest of Mount Lucania and their ultimate salvation through the exercise of resource; some of the greatest difficulties known to mountaineers being surmounted by their own efforts.

The lecture delivered by Mr. Washburn was illustrated with lantern slides, indicating incidents of the climb that contained many elements of romance. Subsequently, a copy of his diary and numerous photographs were made available to the Canadian Geographical Society, material that provides for the presentation of a record that should prove of much interest to its members. Some of the photographs were taken from the air in 1935, two years before the start of the expedition, when a survey was undertaken to determine the most practicable method of approach to the monarch. A selection of these is reproduced herewith.

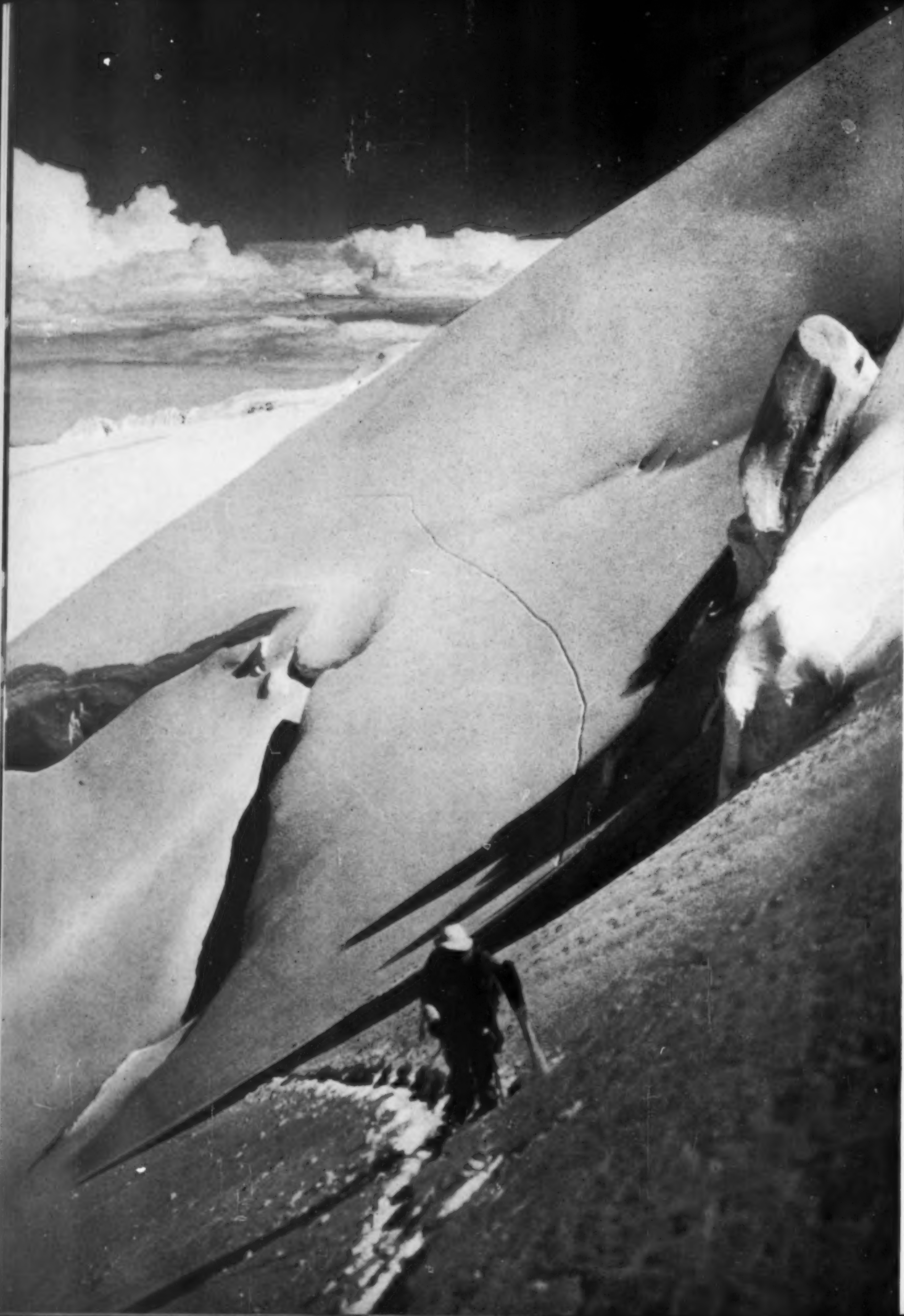
Until its crest was surmounted on July 9, 1937, Mount Lucania was the highest unscaled peak in North America and, from the description of Mr. Washburn, will likely retain its pristine isolation, as he for one would not consider another attempt "for a million dollars." Sighted forty years before, on July 31, 1897, by the Duke of the Abruzzi and his party from the summit of Mount St. Elias, and named for the Cunard liner in which he had crossed the Atlantic, Mount Lucania

Mount Bona (16,420 feet), almost on the boundary of the Yukon Territory and Alaska. This summit was scaled in 1930 by Carpé, Moore and Taylor. This photograph was taken from the air, when flying above a sea of clouds that concealed Skolai Pass below.

has an altitude of 17,150 feet. Peaks in North America known to be higher than this are limited to three: Mount McKinley 20,300 feet; Mount Logan, 19,850 feet; and Mount St. Elias, 18,008 feet.

Although actual climbing conditions in the Yukon and Alaska are not as difficult as in the Alps, the low temperatures, excessive altitudes and the formidable problem presented of reaching the base of the summits involve greater hardship. Examination of aerial photographs indicated that an ascent should be attempted from the southern side, supplies being assembled at Valdez, on the coast, and flown in to the Walsh Glacier. Pilot Bob Reeve and Russell Dow succeeded in establishing a cache of the entire outfit ten miles from the base of Lucania at an altitude of 8,600 feet; by more than 1,500 feet the highest freight landing ever accomplished with an aircraft equipped with skis. Six feet long and eleven inches wide, these were sheathed with a smooth, stainless steel running surface to permit of a take-off from the coastal mud flats in the summer and a subsequent landing on snow fields.

Survey instruments, cameras and food for seventy days were taken in on three flights, Washburn and Bates leaving for their cache on the fourth. Heavy rainstorms had riddled the glacier with unseasonal crevasses, creating a sea of slush, and a torrential downpour accompanied by a rise in temperature to 59 degrees Fahrenheit delayed the party for five days. Then, only after a light freeze, stripping



the plane and almost super-human efforts was it possible for a successful take-off to be effected. As snow conditions made its return with two other members of the climbing party impracticable, all thought of attaining their objective was abandoned by Washburn and Bates. All efforts were concentrated on evolving some means of escape from the ice-clad ring of lofty mountains in which they were isolated.

Several plans were discussed, one involving a climb over an 11,000-foot pass and a long trek through territory about which nothing was known, and another necessitating the ascent of Mount Steele, which had been surmounted two years before by members of the Walter Wood expedition. Although this has an altitude of 16,600 feet, something was known of the route down to Wolf Creek Glacier, the Donjek River and so to Burwash Landing; one that was at least practicable.

With only bare necessities, fifteen hundred dollars worth of cameras, food and camping equipment being abandoned, the two mountaineers set forth, bending every effort to "bring themselves back alive." Weather conditions were terrible, and wide variations in temperature experienced. From two degrees below zero at night, the mercury climbed to 114 degrees around noon, when some relief was secured by digging a hole four feet deep in the snow and drinking lemonade at its bottom, protected from the blistering rays of the sun. Next day a blizzard might bury them deep in snow, such being the nature of that country. Additional supplies and equipment had to be discarded as the climb continued, and the two explorers were even forced to use a single sleeping bag; feet to face. The man on the outside was almost frozen at night, while the other was nearly stewed.

With a slight improvement in the weather after crossing the divide on July 7 at 14,000 feet, Mount Lucania was seen in all its glory. As food for some ten or twelve days would have to be abandoned here in order that the final section of the trip out might be made without relays, it was decided to deliver an attack on the giant, turning a rout into victory. Also, experience in that part of the world over six previous years indicated that usually several cloudless days might be enjoyed between the 4th and 25th of July. Furthermore, it was originally planned to reach this pass on the former date, awaiting an opportunity to strike the final trail.

Progression was not without its difficulties and involved the use of snowshoes. In climbing a 40-degree slope, it was necessary to zigzag back and forth, fifty steps being taken by each of the explorers in turn while breaking the trail. The day was cold and large masses of ice along the face provided a measure of protection from avalanches. Doubt was expressed by Mr. Washburn whether Lucania could ever be considered in good climbing condition.

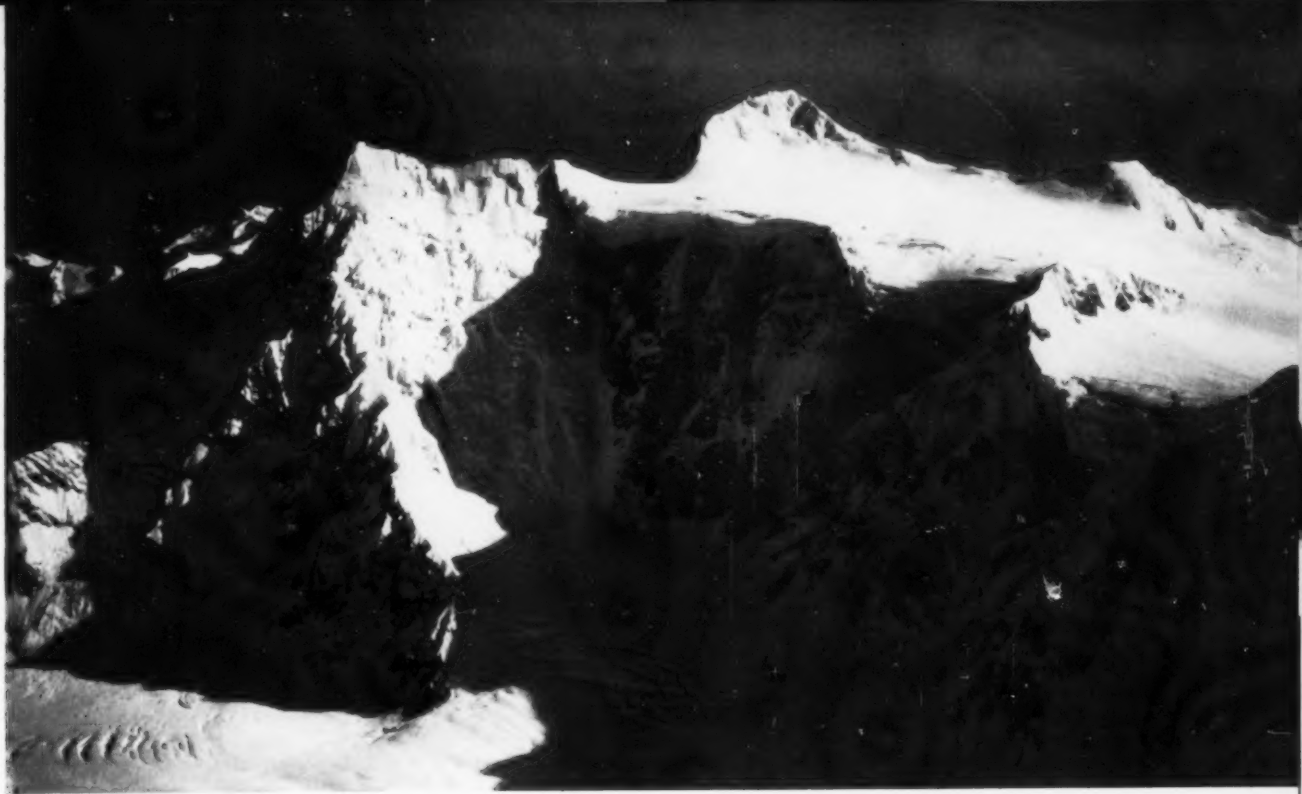
Dates, raisins, a few nibbles of cheese and chocolate sustained the climbers and gave them courage to continue. On reaching their immediate objective, consternation was created when it was discovered that a slightly higher section of Lucania rose to the west. However, this was attained without much additional difficulty, and yells of triumph rent the air. The summit was described as one of those rare peaks that has an ideal observation platform. Weather conditions were perfect, without a cloud in the sky; such as those of which climbers dream, and the temperature was zero. The panorama was magnificent, range upon range of snow-capped, ice-sheathed ridges being seen.

"Every peak from Blackburn to Fairweather stood out crystal clear," it was explained. "Hubbard, East Hubbard, Alverstone, Pinnacle, Jette, Seattle and Vancouver, all old Yukon expedition friends, rose fifty miles to the south. Thirty miles to the west, Logan towered, seeming even larger and more impressive than ever before. The rugged Chitina Glacier, twisted and gnarled with its rocky moraines, stretched westward along its deep, narrow valley. Far beyond its snout a deep green was a joyful reminder that there was still an outside world of something else beside snow and ice. Below us stretched *Changri La*, our trail and old camp site clearly marked on its level white surface. Curious greenish lakes dotted the Walsh and Logan Glaciers. Mount Queen Mary looked enormous. What a wonderful view one could have from her summit, right in the middle of the whole range, and what huge icefields surround her!"

LEFT:—Climbing at 15,000 feet on the north face of Mount Lucania. A great sea of "thunder-heads" covers a section of the Yukon Territory in the distance.

Digging aeroplane out of a crevasse on Walsh Glacier (8,600 feet), after the thin, rotted crust had collapsed under its weight when an effort was made to take off for Valdez, on the coast.

Original "Lucania" party at Valdez before the take-off on June 18, 1937 — Dow, Washburn, Bates, Reeve and Bright. Washburn and Bates "brought themselves back alive" after conquering Mount Lucania. Reeve returned by plane but Dow and Bright could not be flown in.

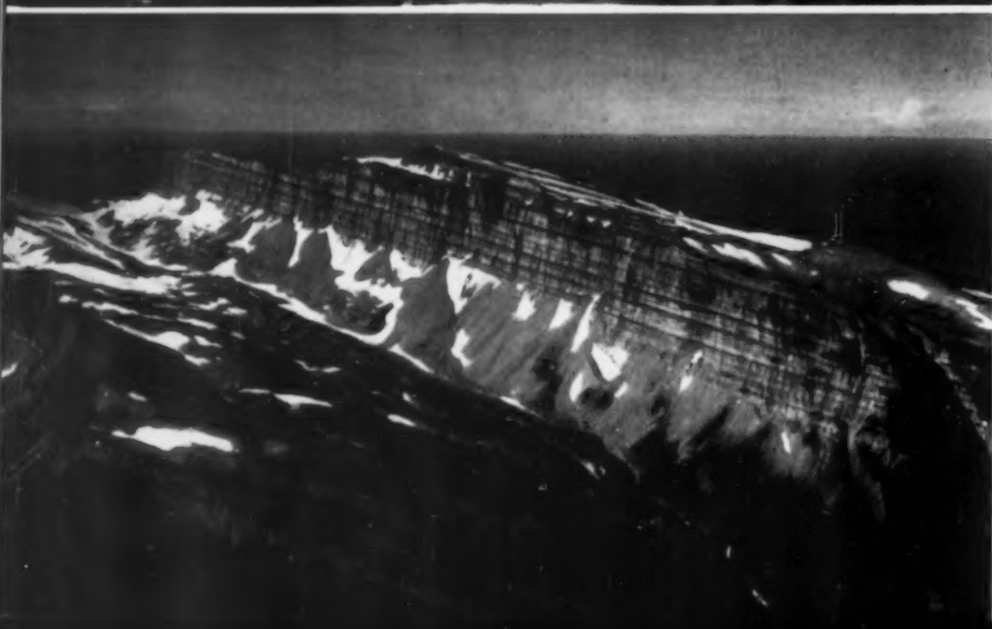


Unscalable easterly cliffs of Mount La Perouse (10,500 feet), one of the most beautiful peaks in the Fairweather Range as yet unclimbed. Pacific Ocean in background.

Head of Wolf Creek Glacier, with its heavy coating of rock debris and moraines. From left to right in background are seen McArthur Peak, Mount Logan, Mount Steele and Mount Lucania, the last two being cloud-capped. The ridge by which Washburn and Bates descended from Mount Steele is clearly visible dropping to Wolf Creek Glacier. (Compare with top photograph on Page 177).

Contorted medial moraines on the surface of Russell Glacier, Skolai Pass, from an altitude of 12,000 feet.

Mount Fairweather (15,318 feet) seen silhouetted against the sky from an altitude of 13.000 feet.



Interesting geological strata etched against a towering precipice. Cook Inlet is visible in the left background.

Forty-five minutes were spent on Lucania, and then the final "fight for their lives" was made by the mountaineers. The retreat out to Burwash Landing over Steele was a veritable nightmare, though a great thrill was enjoyed atop this mountain when a packet of black-tipped willow wands, used to mark the trail through snow and left there by the Wood expedition, was uncovered. These would seem to indicate that snow peaks maintain their altitude exactly from year to year.

Although the final struggle from Wolf Creek Glacier to Burwash Landing was not a tale of mountaineering, it was described in humorous vein as one that nearly broke the spirit of these two men. On reaching the Donjek River, after a sixteen-hour battle with moraines, swollen torrents and packs that seemed to increase steadily in weight, it was found necessary to struggle twenty miles or more upstream before that river could be forded. Two red squirrels and a superb snowshoe rabbit were felled with the trusty pistol and served to replenish the larder, everything but the tail and eyes being consumed. Mushrooms that might have been toadstools also provided sustenance, and a trace of peanut butter found in the bottom of a tin thrown away by some trapper or explorer was considered a rare treat. Though near exhaustion, when they encountered a pack train laying down supplies for a hunting party, Washburn and Bates sat the wooden pack saddles for ten continuous hours through thirty miles of swamp and canyons that reduced them to aching shadows of their former selves. However, grayling from the lake at Burwash Landing, fresh milk from a real cow, mashed potatoes, sheep meat, marmalade, bread, raisin-cinnamon buns and lemon meringue pie with a fine crust made them forget physical tortures, and even those disappeared after a night in a real spring bed, with mattress, clean sheets, pillows and pillowcases. As in the beginning, aircraft served the two intrepid explorers, a plane of Pacific Alaska Airways carrying them off to Fairbanks at high speed.

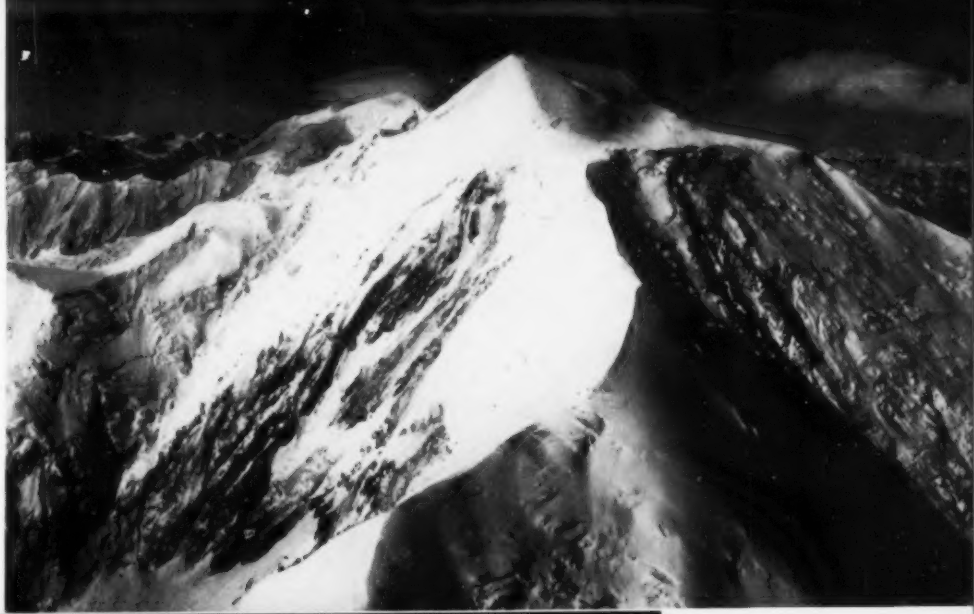
TOP: — Clothesline at an altitude of 9,500 feet, when it was necessary to dry gloves socks and other equipment on one of the "roasting" days when a temperature of 100 degrees was recorded.

BOTTOM—Bates and Washburn on the summit of Mount Lucania (17,150 feet), 5 p.m., July 9, 1937, until then the highest unscaled peak in North America. The camera was tied to an ice axe with a shoestring and the automatic release used.

Red Glacier, which descends southward from Mount Iliamna almost to Cook Inlet, is an amazing study in Morainic debris.

Mount Wood (15,800 feet), in the Yukon Territory, photographed from the air. This is the highest unscaled peak in Western Canada.

Mount Bear (14,850 feet), which is one of the highest peaks in Eastern Alaska as yet unscaled. The Klutlan Glacier fills the foreground.



Mount Lucania, cloud-capped in the distance, with Mount Steele in the foreground. The ridge descended by Washburn and Bates is seen in the centre of the picture.

Mount Crillon, (12,728 feet) on left and the twin peaks of Mount Carpé towering beyond the head of Johns Hopkins Fjord. This fjord was filled with a glacier in 1919, but its retreat has now halted.

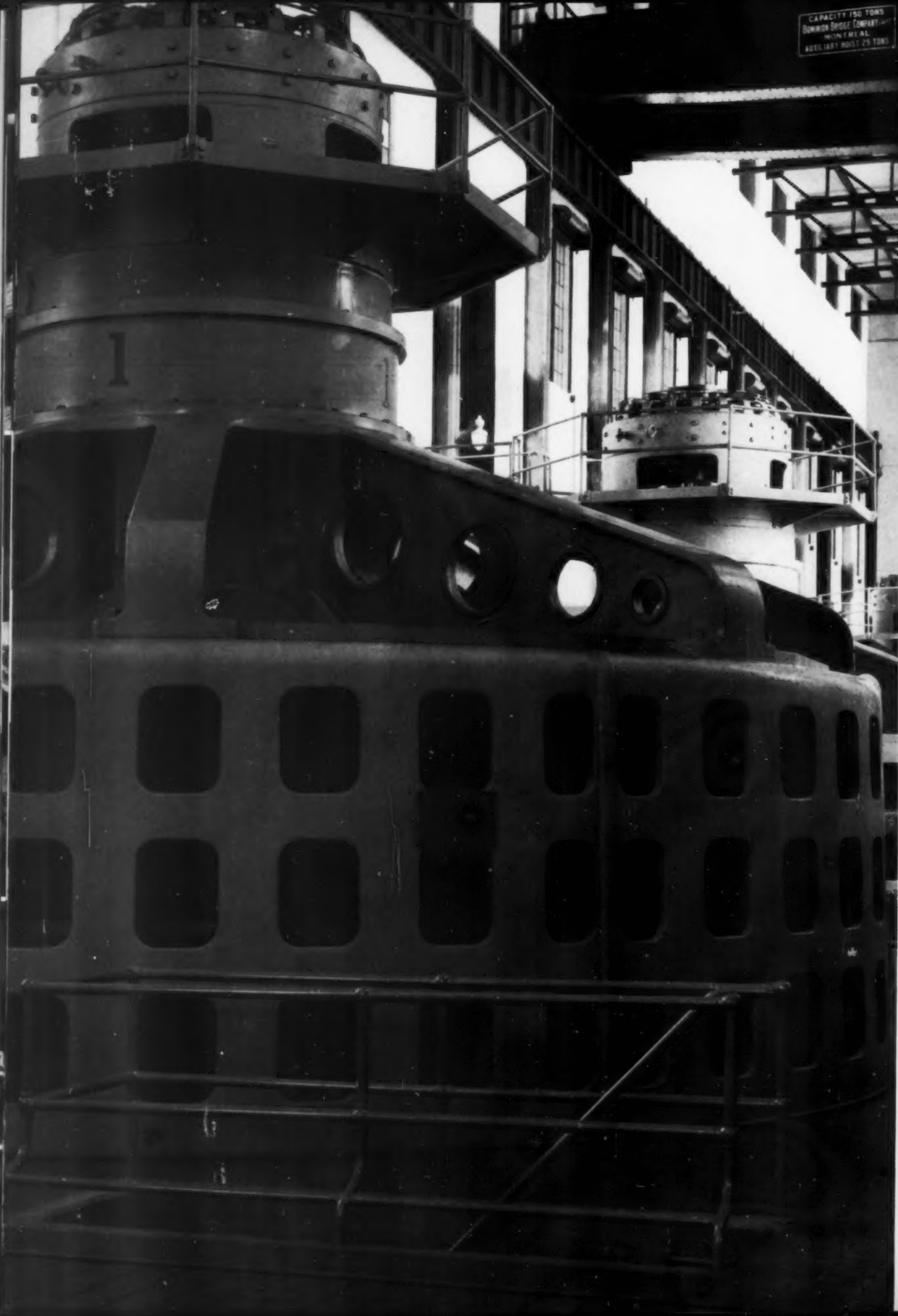
Northern peaks of the St. Elias Range, with Mount Lucania and Mount Steele in the centre and Mount Wood to the right, photographed from an altitude of 5,000 feet. Burwash Landing may be seen on the far shore of Kluane Lake, left foreground.

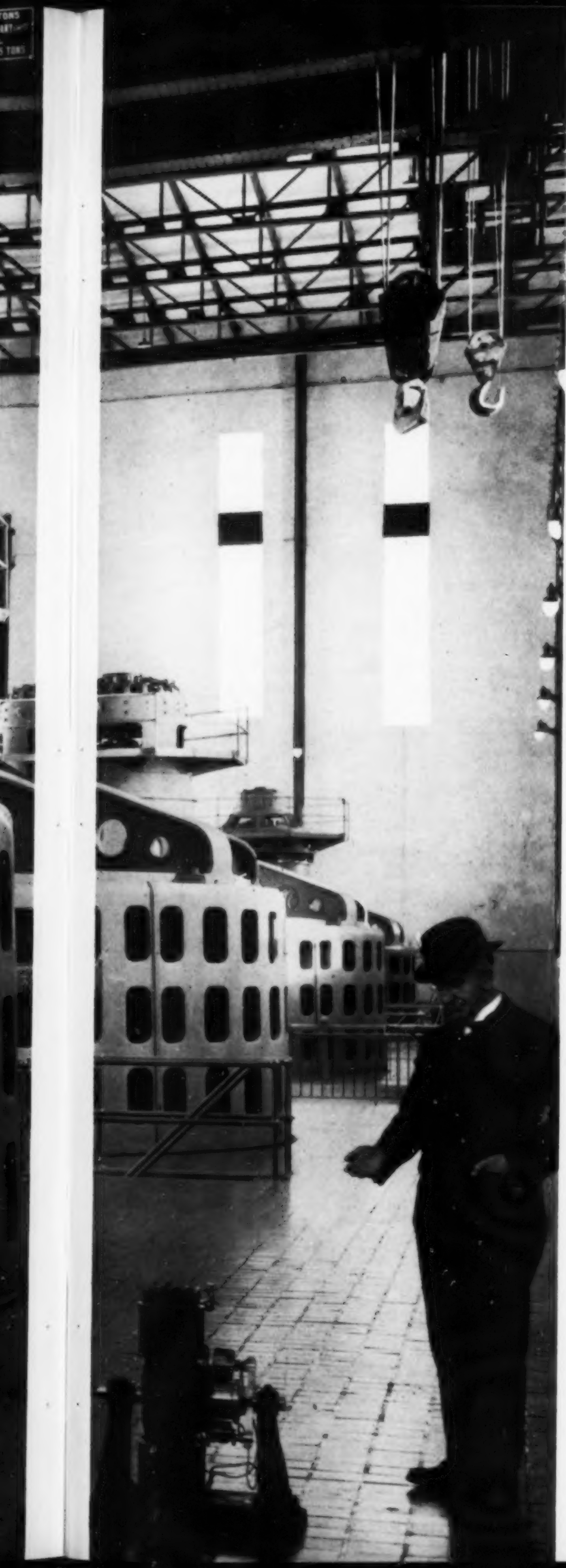
South face of Mount Fairweather (15,318 feet), the first and only ascent of which was made by a left fork of the ridge in the foreground.

Summit ice cap of Mount Wood (15,800 feet), photographed from an altitude of 14,000 feet while flying over the head of Wood Glacier.

Upper icefall of Walsh Glacier with Mount Steele rising 8,000 feet behind. The sledge was used at the base of the icefall, but part of the climbers' supplies had to be relayed by backpacking when the going became too heavy for two men to move it.

Mount Bona looking southward from over the Chitistone Canyon, an angle from which this peak is probably unclimable.


CAPACITY 150 TONS
DOMINION BRIDGE COMPANY
MONTREAL
AUXILIARY HOIST 25 TONS
1



CANADA'S ELECTRICAL MANUFACTURING INDUSTRY

by **J. FERGUS GRANT**

Staff Correspondent

CONFEDERATION was introduced to Canada under the dim rays of a tallow candle, and many problems of this struggling Dominion were solved by the faint illumination cast by paraffin oil until the advent in 1880 of the incandescent lamp. Six years later, and that in which the first Canadian Pacific train from Montreal pulled into Vancouver, an estimated million such lamps were sold throughout the world. Though seemingly large, this figure fades to a mere shadow in the light of the billion mark attained half a century later.

Little more than fifty years have elapsed, therefore, since engineers acquired sufficient knowledge of the electro-magnetic induction discovery of Faraday in 1831 to commence the adaptation of materials and machines to their commercial requirements. Mention may be made of the practical development of telegraphy in 1836 by Cooke and Wheatstone in England, by Henry and Morse in the United States of America and by Weber and Gauss in Germany. Fifteen years later the first submarine cable was laid across the English Channel, and in 1866 the Atlantic was similarly spanned.

Gramme evolved a direct current dynamo in 1872, and the following year it was discovered in Vienna that this would operate as a motor when supplied with electrical energy. The utilization of water turbines was quickly appreciated, and the hydro-electric relationship was early established. Power thereby generated was used in 1882 to illuminate Young's saw mill in Ottawa, where is now located the power plant of the Ottawa Electric Railway Company, southeast of the Chaudière Falls. This is the earliest recorded operation in Canada. The world witnessed the

Progress over a period of half a century is indicated by the contrast between these 34,000 h.p. generators, operating in the Chelsea plant of the Gatineau Power Company, and the small two horsepower dynamo on the floor. The latter was tended some fifty years ago by John Murphy (on right) in Gilmour's Lumber Mills, which formerly occupied the present site of the 170,000 h.p. power plant.

establishment of its first electric tramway in that year, though it was not until 1887 that this form of cheap mass transportation was introduced to the Dominion. St. Catharines, Ontario, is credited with the inaugural system, having a length of seven miles, Vancouver, B.C., following this lead in 1890, Ottawa in 1891, and in 1892 the horse-drawn cars in Montreal and Toronto were superseded with this new motive power.

Earlier electrical developments responsible for the ultimate establishment of a great manufacturing industry in Canada embrace telegraphy and telephony. The first telegraph line was established in 1846-47 between Toronto, Hamilton, St. Catharines and Niagara Falls, and in the latter year the Montreal Telegraph Company connected Quebec with Toronto. Ninety years later, in 1936, there were 363,180 miles of line in this country, and 12,735,186 messages handled. The telephone was actually invented in Canada, and the first long-distance one-way talk conducted by Alexander Graham Bell between Brantford and Paris, Ontario, a distance of eight miles, on August 10, 1876. There were 4,400 rental-earning telephones and 600 miles of long-distance wire in Canada in 1883, and little more than fifty years later, in 1935, the totals had increased to 1,208,815 telephones and 5,120,610 miles of wire, the investment amounting to $327,754,026.

Advances achieved in telephony and telegraphy during recent years, and made possible by the electrical manufacturing industry, contribute in large measure to the interest aroused in geography. The facility with which persons in most parts of the world are enabled to communicate, and the rapidity with which news of events in distant countries is presented to readers of newspapers or radio listeners has created a greater appreciation of geographical knowledge than any other factor.

Annual Production $97,874,052

During the last ten years, apparatus having a gross sales value of $765,452,511 has been produced by the electrical manufacturing industry of Canada. There are 186 establishments listed as purely electrical, located principally in Ontario and Quebec, while many firms of a secondary character are making electrical appliances in addition to other products. Statistics reveal that production for last year amounted to $97,874,052 in value, indicating a remarkable increase from the $72,288,548 figure of the previous year, and that of $61,152,834 for 1935. Whereas the peak was reached in 1929 with a total of $113,796,002, more persons were employed by the industry last year, the respective figures being 21,379 and 20,871.

As quoted by J. T. Johnston in an article entitled "Canada's Water Power Wealth," published in the September, 1937, issue of the Canadian Geographical Journal, "Power has become the most efficient tool of the machine age, enormously lessening manual labour and quickening and rendering more efficient almost every productive activity. Its future expansion holds rich possibilities for material well-being and for consequent leisure and cultural advancement." Thus, the modern home is actuated by electricity. It is lit by incandescent lamps, heated by an electric furnace or one adjusted by the turn of a switch, and provided with a telephone, wireless receiving set and a wide variety of equipment designed for safety, cleanliness and economy of labour. This includes the electric stove, refrigerator, washing machine, vacuum cleaner, coffee percolator, sewing machine, toaster, iron, clock and razor. Even cocktail shakers can be energized electrically, and the lawn mower may be driven by a motor. Among the further domestic applications of this force may be classed the automobile, which incorporates ignition, illumination, starting, radio and even cigarette-lighting equipment, the tram, tube, and suburban train that transport workers to and from their homes.

A large proportion of the western world's urban community considers modern motion picture projection more of a necessity than a luxury, and much of the entertainment is provided through the development of electrical sound equipment. Electrical appliances protect the traveller afloat, ashore and in the air, steamers and aeroplanes being in constant communication with ground stations, while signal systems aid the locomotive engineer and automobile driver. The householder finally sleeps secure in the knowledge that the fire department and police are immediately notified of any outbreak, and are prepared to meet an emergency at a moment's notice; thanks to the manufacture of electrical protective equipment.

Industrial uses range from the manufacture of huge generators in hydro-electric

plants, transformers and other equipment for the transmission of power. Pulp and paper mills and furnaces for the production of special alloy steels, calcium carbide, carborundum, platinum and tungsten utilize the power thus generated. Electro plating with copper and silver was introduced commercially soon after electrolysis was discovered, while nickel, cobalt and chromium are similarly deposited. Many elements and compounds are secured by the electrolytic process, such as copper and aluminum, while nitrogen is derived from the atmosphere and various acids thereby produced. The X-ray tube is used industrially to detect flaws in castings and for research, but its principal service is to suffering humanity in the medical field.

Despite a relatively small population scattered throughout the Dominion, remarkable industrial developments have been recorded by reason of the fortunate proximity of Canada's water power wealth to the rich resources of her fields, forests, fisheries and mines. The hydraulic installation at the beginning of this year totalled 8,112,751 horsepower, which represents, however, only 18.6 per cent, of an estimated 43,700,000 horsepower available. The fact that more than six and a half million of this total is being developed in Ontario and Quebec alone is in large measure responsible for the paramount industrial position occupied by these two provinces.

Industry Ranks Ninth in Canada

The manufacture of electrical equipment in Canada has been stimulated by the appreciation of industry that an abundance of cheap power is available, and the fact that Canada now ranks fourth among the exporting nations of the world may be attributed in part to this factor. Electrical equipment is produced primarily for the domestic market, as indicated by the relatively small volume of shipments abroad, amounting in the last calendar year to $4,309,975 in value. Total domestic exports (all products) for the period attained the handsome figure of $1,110,192,151. Imports of electrical apparatus during the same twelve months totalled $15,506,144, or approximately one-sixth the entire production of such equipment in this country, Nevertheless, the industry ranks ninth in the Dominion, as indicated in the following table, showing 1936 figures:

Insulator manufactured for the 220,000-volt transmission line carrying power to Toronto from Paugan Falls, on the Gatineau, and Chats Falls, on the Ottawa River. (For purposes of comparison, the man at right is six feet tall).

Industries	*Number of Plants*	*Capital Employed*	*Number of Employees*	*Salaries and Wages*	*Cost of Materials*	*Gross value of Products*
Non-ferrous metal Smelting and Refining	15	$143,858,717	10,015	$14,346,050	$154,604,285	$229,737,420
Pulp and Paper	93	539,350,001	30,054	40,063,852	72,202,983	185,144,603
Slaughtering and Meatpacking	142	61,806,675	11,776	13,921,410	126,630,086	156,971,640
Flour and Feed Mills	1118	61,867,287	5,685	5,542,945	90,614,236	114,617,099
Butter and Cheese	2573	60,201,575	15,545	14,772,250	80,983,372	112,712,327
Automobiles	16	46,497,259	12,933	18,164,042	71,201,646	105,350,035
Petroleum Products	63	61,883,926	5,019	7,309,955	66,555,885	85,802,363
Sawmills	3638	78,294,341	28,786	21,357,038	43,598,856	80,343,291
Electrical Apparatus and Supplies	186	79,794,524	17,037	19,501,882	30,484,468	72,288,548

The Census of Manufactures undertaken by the Dominion Bureau of Statistics indicated that in 1936 the industry producing electrical apparatus and supplies also ranked ninth in the Dominion as an employer of labour, though it ranked fifth as a disburser of salaries and wages, so high is the standard of production involved and the class of worker required. For purposes of comparison, the following table is reproduced to illustrate the advance of this industry since 1919, when such figures were first made available. The peak of production was reached in 1929, and the output then declined through the incidence of depression to a low figure in 1933. *(See table below)*

Although electric light made its appearance on the streets of Montreal in 1886, and it is recorded that 13,950 telephones were in service throughout Canada the following year, foundations for establishment of the first plant for the manufacture of electrical equipment in this country were laid in 1888. On December 27th of that year, the late Senator Nicholls headed a group of prominent Toronto citizens who assembled "to enquire into the feasibility of establishing in Toronto an electric plant to supply light and power by means of underground wires." Through the efforts of a syndicate then formed, the Toronto Electrical Supply and Construction Company was incorporated on February 11, 1891, and the Canadian General Electric Company, Limited, less than a year later.

At the time of its incorporation, assets of the Canadian General Electric Company consisted solely of land and buildings at Peterborough, Ontario, and leased branch offices at Montreal, Winnipeg and Vancouver. Now, forty-seven years later, it has five electrical plants, known as the Peterborough Works, Davenport Works, Ward Street Works, Royce Avenue Works and Edison Lamp Works, in addition to the subsidiary Rockfield Works at Lachine, Quebec, of the Canadian Allis-Chalmers, Limited, and the Architectural Bronze and Iron Works in Toronto. Twenty-five sales offices are located across Canada, and approximately 5,000 persons are employed in the organization.

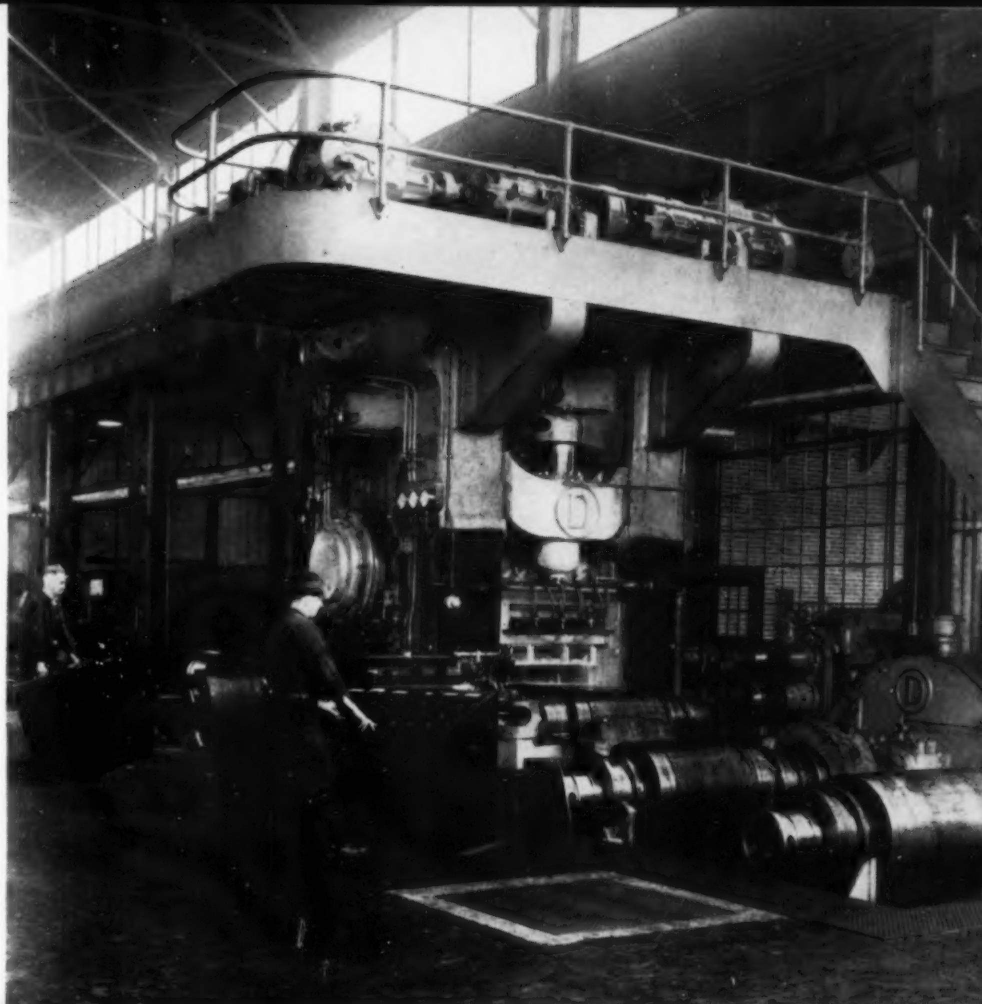
Another pioneer in the manufacturing field was the original Westinghouse Company, which was established in 1896 to produce in Canada air brakes for steam railways. Seven years later the firm was reorganized under its present name of the Canadian Westinghouse Company, Limited and electrical equipment distributed. Progress since then has been rapid, and today two plants in Hamilton, Ontario, extend over an area of fifty-three acres, producing a wide variety of apparatus that ranges from 70,000 horsepower hydraulic generators to small radio tubes. Employment is given to approximately 4,500 persons by this company, and many phases of Canadian development are advanced.

Through the efforts of this organization, a series of radio programmes was arranged some fifteen years ago for the benefit of trappers, traders, Hudson's Bay Company

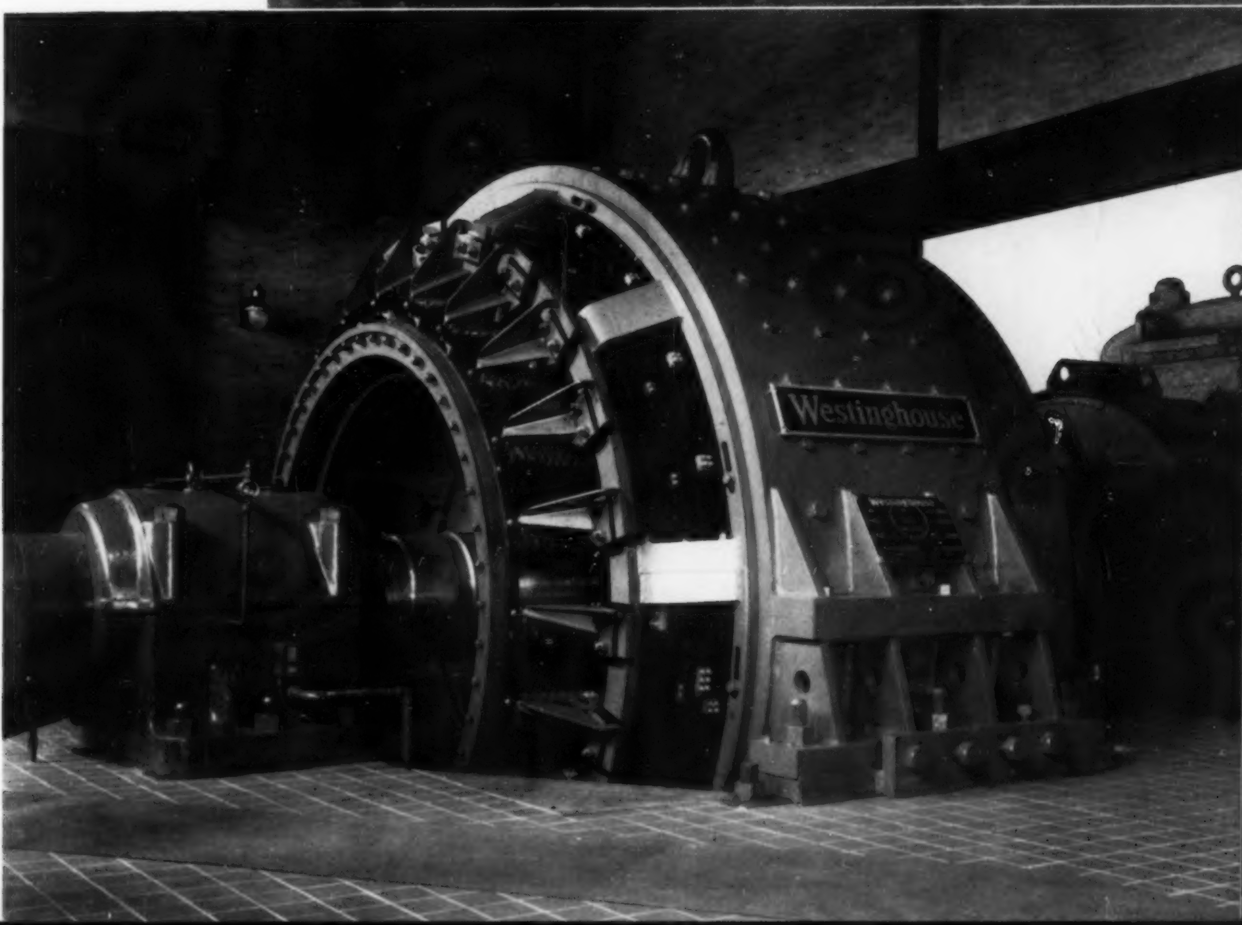
Year	*Number of Plants*	*Capital Employed*	*Number of Employees*	*Salaries and Wages*	*Cost of Materials*	*Gross Value of Products*
1919	100	$46,066,584	9,594	$ 9,729,043	$15,383,577	$34,427,978
1924	109	72,301,204	13,670	16,089,492	24,370,996	56,490,465
1929	139	101,767,108	20,871	26,725,215	49,623,322	113,796,002
1933	174	80,844,131	11,767	12,428,430	14,504,269	37,012,509
x1937	186	97,387,170	21,379	26,156,335	41,251,754	97,874,052

xFigures for 1937 are preliminary, and are liable to subsequent revision.

RIGHT:—Two men control at the "pulpits" the operations of a tin plate mill, thereby supplying the requirements of Canada's canning industry.



BELOW: — Largest direct current electric motor in Canada, which is operated in the blooming mill of a steel company. This giant is rated at 7,000 h.p., and can develop a peak load power as high as 18,000 h.p.

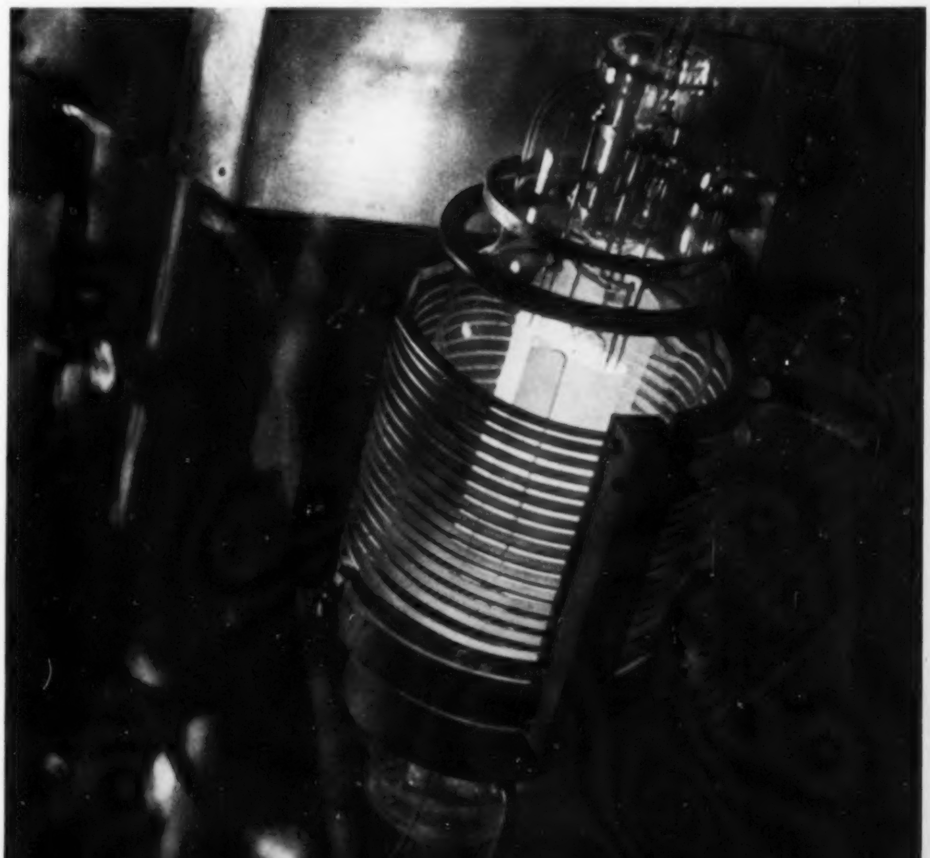


Electrical stethoscope, a product of the Bell Telephone Laboratories, which has revolutionized the diagnosis of pulmonary disorders.

Telephone repeater tubes being sealed in the plant of the Northern Electric Company, Ltd., as they come off the vacuum pump.

Testing central office equipment through which some 6,000,000 telephone calls are made per day by Canadians.

Large broadcasting vacuum tube in the vacuum pump, where all gasses are withdrawn from the heated elements.



factors, missionaries and the Royal Canadian Mounted Police stationed in the Far North. Wireless receiving sets penetrated the Arctic wastes, being carried north by one or other of the supply ships on its annual visit to distant posts. Lists of the dates and hours on which messages from friends, news summaries and other radio entertainment would be broadcast from station "KDKA" were also distributed, and the isolation of Canada's northern frontier was gradually broken down. It is recalled that the late Inspector Joy, of the R.C.M.P., was surprised one Christmas Eve in his post on Bache Peninsula, and only five hundred miles from the North Pole, when a faint sound came from his formerly silent instrument. A voice explained that a special message was being broadcast for his benefit, as the most northern resident in the world, and conveyed to him information concerning adjustments that might improve the quality of reception. On another occasion, he was informed that the supply ship would be unable to reach Bache Peninsula through heavy ice, and that his supplies for twelve months would be discharged at Etah, across Smith Sound in Greenland, where he subsequently secured them.

Communication Equipment

Among the roots of the electrical industry in this country is found the Northern Electric Company, Limited, which originated in July, 1882, as the manufacturing and repair department of the Bell Telephone Company of Canada. From a small building at 22 Craig Street, West, Montreal, material expansion was undertaken, so great was the demand for telephones, electric bells, burglar alarms, etc., and in 1896 the Northern Electric and Manufacturing Company was established. Another important advance was achieved by the amalgamation in 1914 of this company with the Imperial Wire & Cable Company, Limited, which had commenced operations in 1899 as the Wire and Cable Company, its plant in Montreal being equipped for the production of bare and insulated wire and cables for telephone, telegraph and other electrical purposes. Twenty-one branch sales offices of the Northern Electric Company, Limited, extend from Halifax to Victoria, B.C., and credit for the introduction of many interesting electrical services to Canada is claimed for the engineers of this organization and those of the "Bell" system, with which it is closely associated.

Canadian electrical pioneers to whom much credit is due include the late Hon. Thomas Ahearn and W. Y. Soper, who introduced the first electric street cars to Ottawa in 1891. The former recalled on one occasion that critics declared these vehicles could not be operated in Canada's capital during the winter, as their passengers would suffer from the extreme cold. When, however, some of the more daring of these individuals boarded one of the street cars while the mercury hovered below zero, they were astounded. Instead of the frigid atmosphere they had anticipated, one approximating that of the balmy south greeted them. Instead of the warmth being created by the sun above, it came from below the seats. Their scepticism "melted" and they were convinced that a miracle had been performed before their eyes.

These young engineers were not content with a single victory, and arranged a banquet in the old Windsor Hotel to honour a number of visitors who had flocked to Ottawa for inspection of the new electric heating equipment installed in the cars. Their credulity almost failed them when, after extolling the merits of Ahearn and Soper, and expressing appreciation for such fine hospitality, they were told that everything had been cooked by electricity. Great was their astonishment when confronted with a large electric oven, on which half an ox, vegetables and even dessert could be prepared at the same time — the first of countless electric stoves on which meals for millions throughout the world are now cooked. That was on April 3rd, 1893, just forty-five years ago, and it was no product of the preceding All-Fools' Day.

Modern Industry Mechanical

Modern industry is machine industry. In Canada the generous use of electric power enhances the production value of labour and thus materially contributes to the comparatively high standard of living enjoyed. The type of industry characteristic of this country is one that, generally speaking, utilizes large quantities of natural resources, employs labour at relatively high wages, supplies it with ample machinery, and uses a large amount of mechanical power for motivation.

The extent of electrification in industry is a recognized and dependable index to

the progress of industrial development in any country. Electrical energy is the most economical and flexible means of applying mechanical power. It can be applied directly and efficiently to the work in hand. The development of the means of utilizing electrical energy in manufacturing has been an important influence in the extension of industrial activity from the large cities to the smaller towns, in the promotion of industrial safety by eliminating overhead shafting and belts, and in the revolution of mining and metallurgical processes. Those countries that have electrified a high proportion of their industries are ordinarily possessed of more modern methods and are more efficient in production than are those whose industries have been but partially electrified.

The electrical manufacturing industry comprises a group of industries which make a line of equipment as varied almost as an encyclopaedia. Each item of manufacture is in a constant state of change through the introduction of improvements by research or new inventions. Developments during the past few years in the efficiency of such commonplace articles as electric lamps, radio sets, electric refrigerators and other domestic appliances reveal that the industry is progressing rapidly. Similar improvements are being effected in the more direct industrial application of electricity.

The electrical industry of Canada uses a wide variety of products, the basic materials being steel and copper. During 1936, it consumed 35,000 tons of iron and steel, 15,000 tons of copper, 11,500 tons of lead, 1,500 tons of brass, 1,500 tons of zinc, 750 tons of aluminum and 380,000 gallons of insulating oil. Its contribution to the national economy is seen to be due in part to the purchase of many other products on which considerable manufacturing effort has been expended. For instance, in the manufacture of a large power transformer, forty-two separate materials are required, each of which involves some form of fabrication, while adjuncts such as gauges, thermometers and indicators have to be furnished. Asbestos and mica are found in Canada, though some mica for insulation comes from India, which country also supplies shellac. Frit, used in porcelain enamelling, was hitherto imported, but is now being produced in this Dominion. Tungsten, for lamps, is brought from China. The industry buys from Canadian sources wherever possible, and, as the demand increases, more material will be made available by Canadian factories. Among the principal products of this character now being supplied to the industry are bolts, nuts and screws, transformer and switch oil, radio cabinets, paint, kraft paper, resistance wire, rubber, steel tanks and sulphuric acid.

Wide Range of Electric Appliances

Excluding the manufacture of motors, generators and transformers, the gross sales value for which was $19,513,644 in 1936, there is a wide range of appliances produced by the industry. Examination of the following figures for 1936 will provide a clearer conception of the important position it occupies in this country.

Products	*Number*	*Gross Value*
Complete radios.	253,896	$11,388,173
(1926 figure)	42,430	2,253,098
(1924 figure)	....	225,000
Copper wire and cable	....	10,155,326
Electric refrigerators	46,325	5,934,962
(1929 figure)	4,687	1,608,304
Storage batteries	635,339	3,275,369
Dry cell batteries	33,519,310	2,308,608
Electric washing machines	89,334	4,331,912
(1927 figure)	38,409	4,606,631
Standard lamps	24,364,181	4,117,871
Miniature lamps	11,246,707	662,628
Telephone equipment	....	2,979,534
Furnace electrodes	....	2,318,488
Electric stoves	29,442	2,097,256
Vacuum cleaners	47,679	1,930,146
Lighting fixtures	....	1,850,195
Automobile generators and starters	....	1,568,192
Radio receiving tubes	2,952,415	1,545,823
(1929 figure)	2,924,270	3,100,148
Electrical conduit	....	1,044,708
Electric signs	....	1,134,411
Switchboard panels	....	1,001,344

A material decline in unit cost is shown for certain products, when compared with figures for preceding years, as in the case of electric refrigerators, washing machines and radio receiving tubes.

The manufacture of equipment for the generation, transmission and distribution of electrical energy, and also for its utilization in the domestic field, involves the production of numerous dies and tools, many of which have to be replaced or changed when any modification or improvement in the apparatus is effected. Material developments in the transmission of power alone involve costly alterations. Generated at voltages rising to 13,000, electric power is immediately transformed for purposes of transmission to voltages as high as 230,000.

Transmission towers, of graceful and functional design, are familiar structures in various parts of Canada, sometimes etched against the sky and at others set in a wide swathe cutting through miles of virgin forest. They literally carry the life energy of the nation on strands of copper or aluminum.

The longest transmission line in the Dominion is that between Beauharnois and Toronto, which is just over three hundred miles. Canada has pioneered in the transmission of electric power, the first high tension line in the British Empire being from St. Narcisse to Three Rivers, Quebec—a distance of seventeen miles—inaugurated in 1896. Two years later the De Cew Falls station of the Dominion Power and Transmission Company generated electrical energy that was transmitted the "amazing" distance of thirty-three miles to Hamilton, Ontario. It was indeed a courageous undertaking; Lord Kelvin, the noted British physicist, declaring at the time it would not be possible. The success of this and subsequent projects has paved the way, not only for the electrical industry, but for the vast pulp and paper, electro-chemical and electro-metallurgical industries, all of which are such heavy consumers of hydro electricity.

When a transmission line reaches a city or plant in which its energy is to be utilized, the high voltage has to be "stepped down" again by means of transformers to a voltage that can be more readily and safely distributed. From the main substation, all sections of a city are reached through a network of wires and transformers, and eventually the householder receives this invisible force at the usual domestic voltage of 110/220; the lower for illumination and the higher for electric stoves and water heaters.

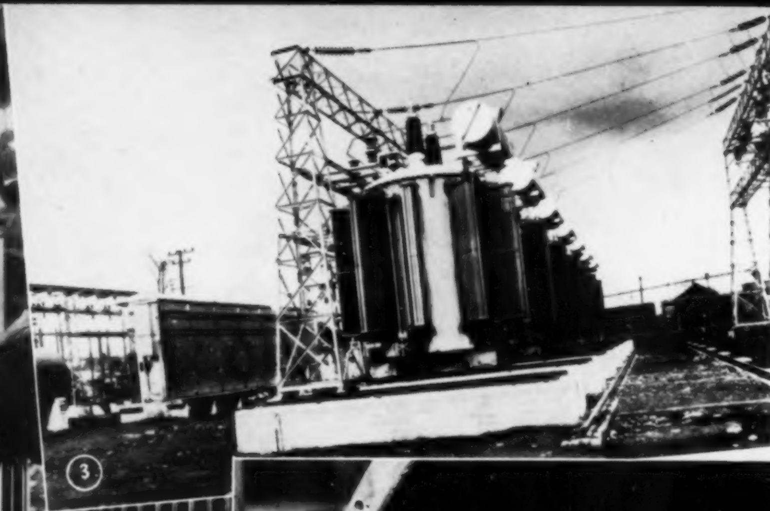
Great problems had to be solved before anything like a continuous flow of electricity could be secured from distant generating stations. In the solution of these, electrical manufacturers in Canada have participated in no small measure. Devices of every possible design, such as lightning arresters, disconnecting switches and relays have been produced to ensure a continuous flow during a variety of climatic conditions that include even violent thunder storms. Besides the large transformers at either end of the transmission line, there are circuit breakers. This massive apparatus is designed for opening and closing the line when necessary. Everyone is familiar with the small arc formed as a switch is closed, or when a small piece of electrical equipment, such as an iron or toaster, is disconnected from the circuit. When, therefore, a transmission line carrying current at 230,000 volts is opened or closed, it can be appreciated that tremendous forces must be mastered for the protection of man and the materials involved. The solution of problems connected with arc extinction is one of the principal concerns of research laboratories and electrical manufacturers.

Standardization Supported

Standardization has been readily supported by the electrical industry in Canada, and this has been one of the important factors in its rapid development. In the early days, generating plants were small and served very limited areas. With no guidance, owners of such plants selected any current specification that seemed most suitable for their particular requirements. One manufacturer of motors might rate his fractional horsepower equipment in increments of 1/8 h.p., while another rated his product in increments of 1/3 h.p. There were no standards of insulation for electrical apparatus, no standards of safety and no standard fuse sizes. Temperature ratings were different with each manufacturer. Even electric lamps would not always fit the same socket. Conditions soon became chaotic, and electrical manufacturers (among them Canadian) co-operated to produce a degree of standardization that has enabled the industry to advance in an orderly manner.

The economic advantages of standardization are so great that, in spite of the occasional criticism of the restriction of individuality and artistic instinct or design, it has become accepted in principle and is being adhered to in practice. Standardization in Canada had its inception in 1917 with the issuance of letters patent to the Canadian Engineering Standards Association. The main purpose of this organization is to promote the establishment of industrial standards by providing a bureau for the receipt of requests for standardization, to investigate their desirability and to arrange for the formation of committees representing both manufacturers and consumers in order to determine the standards acceptable to all interested parties. The Association follows as closely as possible the standards of similar bodies in other

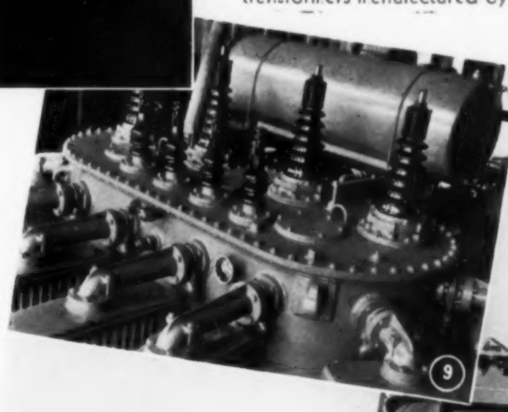
Wide variety of electrical equipment manufactured in Canada for use in the home and on the farm. This includes ranges, hot plates, washers, vacuum cleaners, water heaters, grates, air heaters, ironers, irons, refrigerators, toasters, radios, percolators, clocks, grain grinders, milking machines, milk coolers, cream separators, churns, incubators, brooders, air compressors and battery chargers.



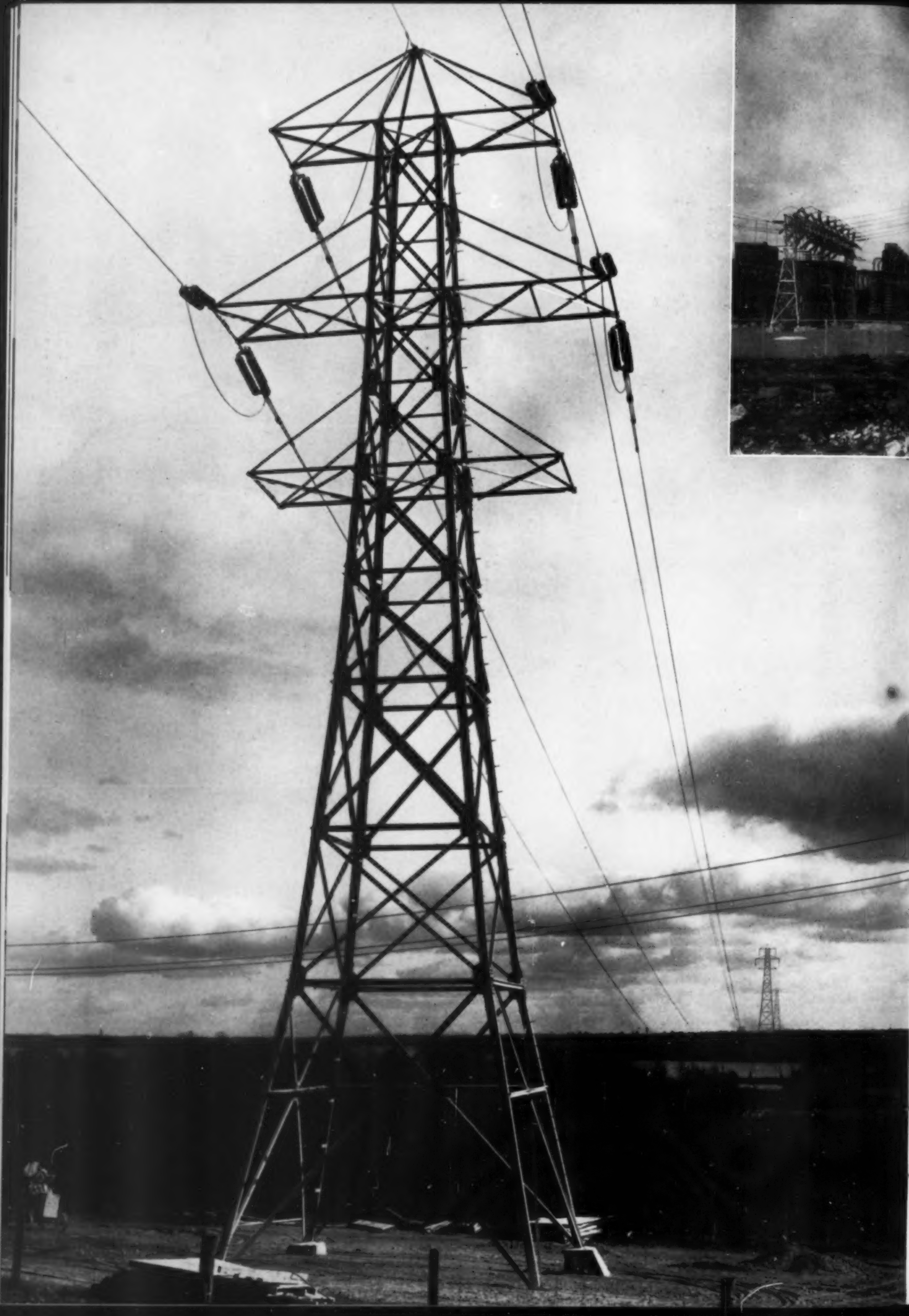
(1) Assembling a transformer unit in the plant of the Ferranti Electric, Limited . . . (2) Cores of Canadian Westinghouse transformers, rated at 46,500 k.v.a. and among the largest in the world, before their insertion in tanks . . . (3) Seven General Electric 5,000 k.v.a., 110,000—26,400 volt transformers at the Port Colborne substation of the Hydro Electric Power Commission of Ontario . . . (4) Arc welding cooling tubes on a steel transformer tank.

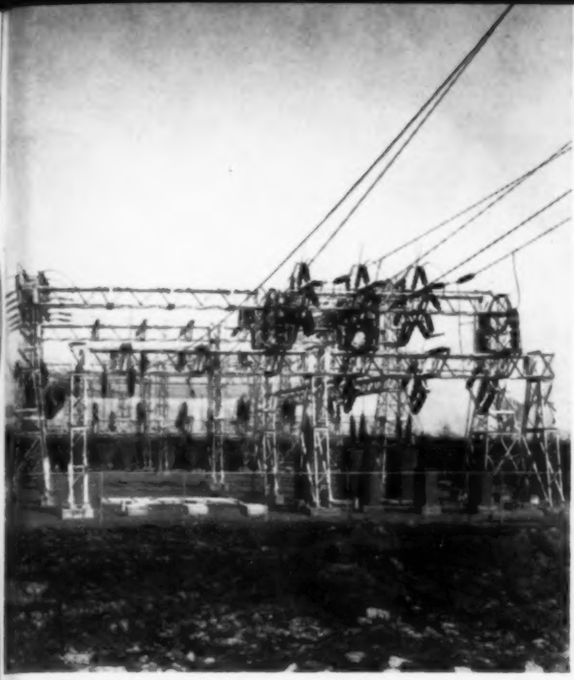
Power transformers, which "step down" high transmission voltages for safe domestic and industrial purposes. A total of 250 power transformers, having a sales value at the works

(6) Seven General Electric 2,500 k.v.a., 60,000—2,400 volt transformers at the Bay Street substation in Victoria, B.C., of the B.C. Electric Railway Company . . . (7) Three General Electric 300 k.v.a. transformers on a scow at Hudson, Ont., awaiting shipment to the Red Lake mining area . . . (8) Because of railroad clearance limitation, this General Electric 36,000 k.v.a., 230,000-volt transformer had to be routed over 1,000 additional miles to its destination. (9) Three-phase power transformers manufactured by the Moloney Electric Company of Canada, Limited.



of $1,194,549, were manufactured in Canada during 1936. Distribution, current and potential, radio and other transformers raise this value to a total of $2,893,156.





ABOVE—Switching structure at Val Tetreau, Que., where an incoming voltage of 110,000 is "stepped-down" and distributed.

LEFT—Gatineau-Hawkesbury 110,000-volt transmission line of the Gatineau Power Company, showing the river crossing from Calumet to Hawkesbury. Graceful towers of this character support the wires that carry the life energy of the nation.

parts of the world, drafting specifications to meet the requirements of and to operate in the best interests of Canadian industry. One of the outstanding achievements of the Association has been the compilation of the Canadian Electrical Code, which has been officially adopted throughout the Dominion.

National Research Council Assists

Material contributions to the electrical industry are being made by the National Research Council, the president of which is a member of the executive of the Canadian Engineering Standards Association, and on whose committees are represented technical officers of the National Research Council. Although the laboratories in Ottawa are utilized primarily for research purposes, their facilities provide protection for the smallest consumer of electricity in the same way as is done for the distributor of power and the manufacturer of equipment. Here are located the Canadian standards of voltage and resistance, which enable that of current to be established. Twenty voltage cells are inter-compared each week, and four of these are sent away every year for comparison with those of the National Physical Laboratory in Teddington, England, or with those of the National Bureau of Standards in Washington, U.S.A.

Further standardization throughout the world is effected by the International Bureau of Weights and Measures in Paris, which provides for comparison of the British and American standards with those of the Physikalisch-Technische Reichsanstalt in Berlin, the Laboratoire Central d'Électricité in Paris, the Laboratoire Électrotechnique de Tokio, and l'Institut de Métrologie de l'U.R.S.S. in Leningrad. The unit of resistance is the ohm, and standard coils at the National Research Council are similarly compared with those of other countries through its membership in the International Bureau of Weights and Measures.

Greater confidence can be reposed by the Canadian consumer of electricity in all phases of the industry than is possible in either Great Britain or the United States. This is made possible through the Electricity and Gas Inspection Service, which has been functioning since 1894. Though administered by the Department of Trade and Commerce, it is housed for convenience with the National Research Council. All new types of measuring equipment used for billing purposes have to be approved in the National Research Laboratories before distribution in Canada, whether manufactured here or in other countries, and every meter must be examined by the Electricity and Gas Inspection Service once every six years. The "red seal" of government inspection provides the guarantee that creates and maintains confidence in Canada's public utilities.

Legislation of a somewhat similar character was only enacted by Great Britain in 1936, and the regulations became mandatory as recently as last July. Furthermore, only ten per cent of the meters need be inspected in the United Kingdom. State legislation prevails in the U.S.A., where thirty-five different systems are in effect; and in some states meters are inspected only on request. Public utilities defray the cost of inspection in Canada and Great Britain, while the government in this country provides the testing equipment and standards.

Lamp Standards Maintained

Primary standards of candle power are maintained with six carbon lamps that are

burned for no more than fifteen minutes each year. In addition, several groups of tungsten lamps serve as primary standards, which are compared periodically with those of Teddington and Washington. These enable other groups of lamps to be calibrated from time to time as working standards, thereby preserving the originals. While the National Research Council assists in the preparation and maintenance of lamp specifications, full credit is accorded the manufacturers for improvements effected. Temperatures of wire filaments are being steadily increased to secure a brighter light, that of the gas-filled tungsten lamp ranging from 2700 to 3000 degrees centigrade, as compared with the carbon lamp having a temperature of 2000 degrees. It is worthy of note that material improvements have been made by the manufacturers on their own initiative since October, 1923, when the most recent set of specifications was issued by the Canadian Engineering Standards Association.

Illumination of a high efficiency is now being provided by a new arc-type of lamp that is tubular in form, and being produced commercially for certain specific purposes. It resembles the tubular arc-types now employed for advertising signs, with the exception of the layer of fluorescent salt with which the inner surface is coated. However, each lamp is manufactured at present only in straight sections, and requires an auxiliary coil for the operation of the arc. Ultra-violet rays in the electric arc, which is sustained through the medium of mercury vapour, cause these salts to fluoresce, and a white light suitable for domestic purposes or one in a variety of colours for other purposes is created. The durability of such lamps is expected to exceed that of incandescent lamps, and the light output for the amount of power consumed is greater. Loss of efficiency through the generation of heat will be materially reduced.

Electrical discharge from a positively-charged point. Discharge patterns of this type may be used to study characteristics of an electric "surge."

It is maintained that the lamps at present available will be used largely for decorative lighting, though the daylight fluorescent lamp should prove popular where a daylight colour quality is desired. It presents many opportunities to architects, decorators and builders, and a large number have been ordered for the New York World's Fair.

The life of a lamp is guaranteed at its rated efficiency, and those purchased for household use will burn on an average for 1,000 hours. A high standard is maintained, lamps manufactured in Canada having greater durability and being more efficient than many imported from countries with no established rating. The public is urged, therefore, to protect itself through the purchase of Canadian lamps, or to inquire concerning those of foreign manufacture with a possible lower durability.

During the year 1936, there were 24,364,181 standard size incandescent lamps manufactured in this country. With a selling value at the works of $4,117,871, the unit cost was 16.9 cents, which is a remarkably low figure considering the difficulty experienced in "drawing" tungsten. In the same year, there were 11,246,707 lamps of a miniature size manufactured in Canada. The gross selling value being $662,628, the unit cost was only 5.9 cents. Imports of incandescent lamps with metal filaments totalled 3,780,325 in 1936. Last year, however, the figure rose to 9,690,269. At a valuation of $251,095, the unit cost was only 2.6 cents. Of this large total, imports from Japan were 7,309,260, compared with only 792,552 the previous year, and the valuation of $124,877 indicated a unit cost of 1.8 cents.

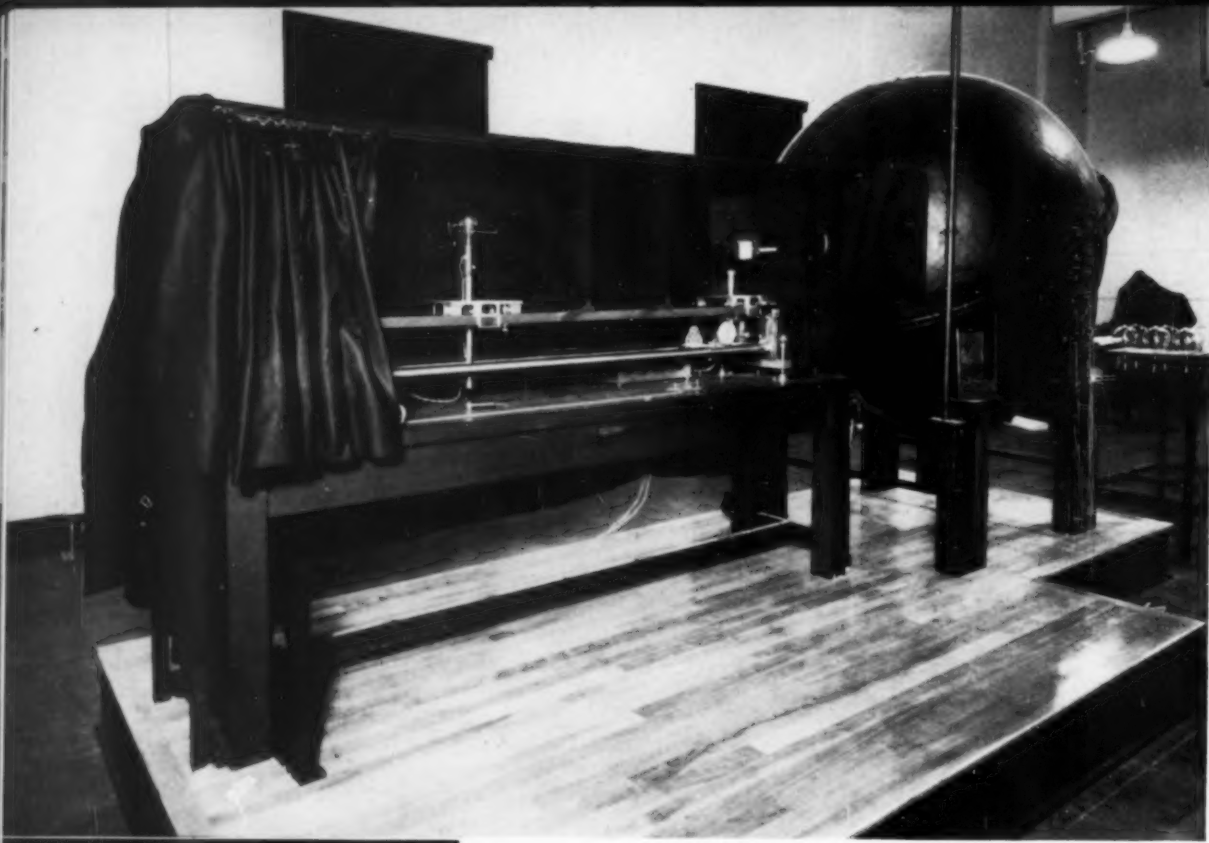
New High Voltage Laboratory

Canada being confronted with the problem of high voltage transmission to a greater extent than any other country in the world, plans are being made to equip the National Research Council with a high voltage testing laboratory, three transformer units of 500,000 volts each being installed. No laboratory in Canada can produce a voltage in excess of 700,000, at commercial frequencies, and the highest in the United States is two million volts, at 60 cycles. The National Research Laboratories are prepared to provide higher voltages at a frequency of 25 cycles than any other laboratory on this continent, and, as most of the very high transmission lines in Canada are operated at this particular frequency, the facilities thus made available for the study of electrical phenomena under such conditions should be invaluable. It is estimated that the voltage capacity for test equipment should be twice the maximum line voltage, while test laboratories should be enabled to experiment with four times the maximum line voltage. With a total of 1,500,000 provided by the three new units, the National Research Council should be in a position to study problems involving the present maximum transmission voltage of 230,000 and even higher. Consideration may even be given to the question of direct current transmission, as opposed to alternating current transmission over long distances at high voltage. Much research has been undertaken on this phase of transmission, as that by direct current would appear to offer many advantages of an operating and economic character that cannot be secured from alternating current transmission. Although some success has been attained by direct current transmission in Europe, it is not economical at its present stage of development, and one Canadian organization is now contemplating the installation of a 500,000 voltage transmission line carrying an alternating current. Every effort is being made to increase further the efficiency of power transmission, transformation to lower voltages and general distribution for industrial and domestic purposes. In view of the leading position occupied by Canada as a producer and consumer of electrical energy, it is maintained that she should become less dependent on foreign laboratories.

Further research in the possible elimination of ravages attributed to lightning will be facilitated through the equipment of the National Research Laboratories with a "surge" generator that can simulate an electrical discharge of 3,000,000 volts. That at present in operation has a rated voltage of one million, and additional condensers have just been received to produce a discharge of two million volts. Closer co-ordination within the entire insulation system of transmission lines is anticipated as a result of the provision of such research facilities, affecting the efficiency of transformers, circuit breakers, insulators, etc. In conjunction with this generator, a cathode ray oscillograph (an electric pen that will record on sensitized paper at the rate of 3,000 miles a second with a stream of electrons) is being produced to secure a graphic description of electric phenomena.

Many problems are peculiar to the electrical industry in Canada. The manufacturer, for example, must take into consideration the relatively small population of this country, and the fact that mass production methods as practised in the U.S.A. are not fully applicable to this Dominion. Difficult climatic conditions also involve the design and fabrication of special equipment, but the experience

Electric discharge from a negatively-charged point. Much of the delicate tracery to be seen in the photographic negative is lost through reproduction.

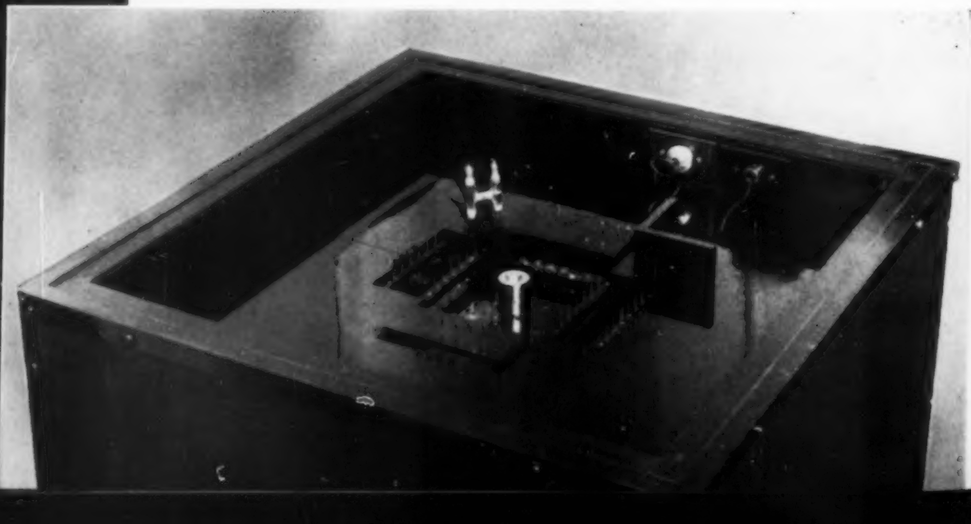


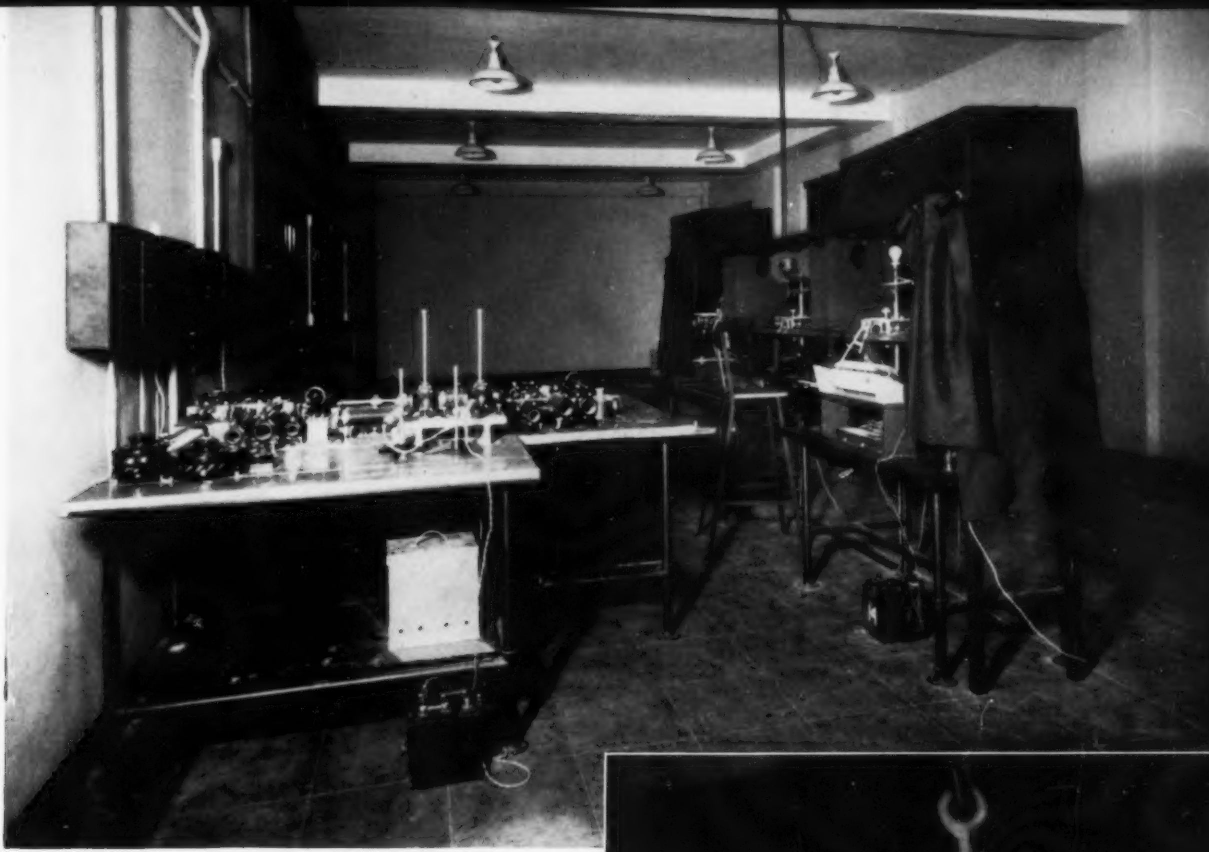
NATIONAL RESEARCH LABORATORIES
(Ottawa)

TOP:—Photometric sphere and photometer bench used for measuring spherical candle power and in the standardization of electric lamps.

CENTRE:—Discharge of 900,000 volts over a wooden pole, which was split into a number of sections. This experiment simulates the effect of lightning, and is made possible with a "surge" generator whose capacity is being increased to 3,000,000 volts.

BOTTOM:—Precision standards of electricity, light, heat, sound, etc., are maintained by the National Research Council. The Canadian voltage standard is preserved with twenty standard cells, contained in the bath here illustrated, and the temperature of which remains constant. One of these 20 units may be seen above the top corner of the bath.

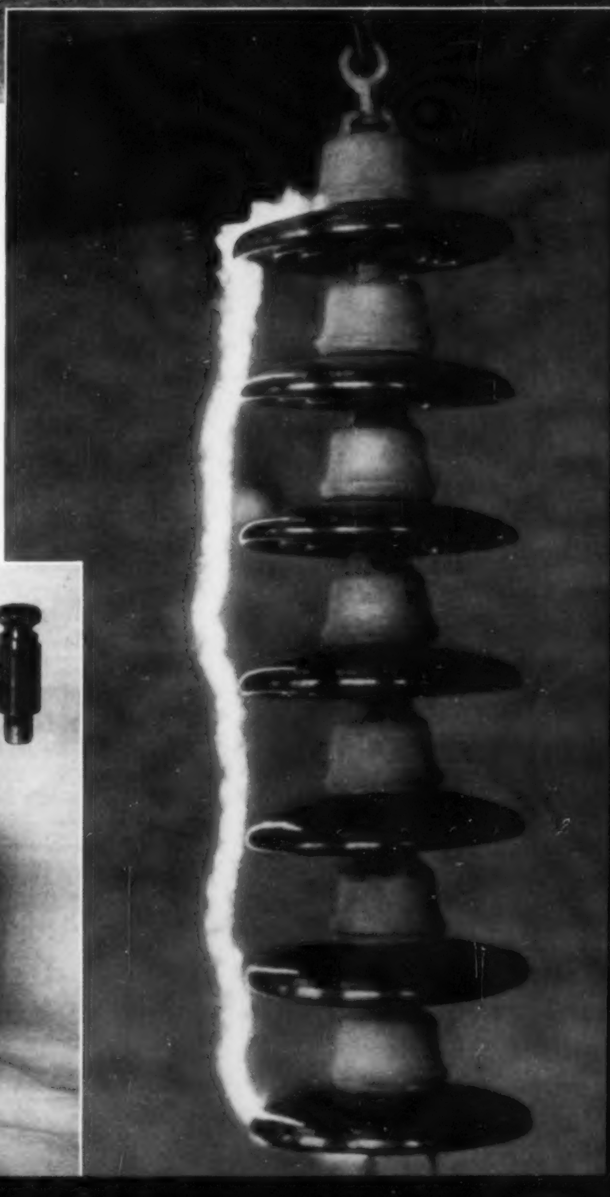




TOP:—Equipment used to control and measure the electrical power supplied to lamps under test with an accuracy of .01 per cent. The efficiency of a lamp is determined from measurements of light output and electrical power supplied. Photometer bench on right is used to measure horizontal candle power.

CENTRE:—Electrical discharge over a standard transmission line insulator from a million-volt impulse generator. The effect of surges produced by lightning on electrical power equipment is studied.

BOTTOM:—Standard resistor that enables electrical resistance to be determined. From the standards of voltage and resistance the standard of current is derived.



Metal spinning operation involved in the manufacture of lamp reflectors for industrial use by the Amalgamated Electric Corporation, Limited, in Toronto. Commencing as a circular disk, the reflector takes form as pressure is applied by an experienced machinist.

secured by the Canadian engineer in solving unusual problems enhances his prestige in a profession that presents greater possibilities in this country perhaps than in any other part of the world.

Per Capita Consumption High

The degree to which Canada has attained her high industrial position through the employment of electric power is not generally recognized. In proportion to her population, this country employs more electrical energy than any other nation except Norway, surpassing even the United States of America. Each individual in this Dominion can be assessed with three-quarters of one horsepower, which compares with only one-third of a horsepower per unit of population in Great Britain or Germany. The absence of coal in the central provinces and the large amount of water power available within transmitting distances of the principal manufacturing centres is responsible for the extensive employment of electricity produced by central stations. The pulp and paper industry uses about forty per cent of the total energy generated by these plants, and seven per cent is used by electric furnaces. The per capita consumption of electricity in Canada, compared with other countries, is shown in the table on opposite page.

Over 88 per cent of all water power developed in this country is produced by central electric stations and, although there are 250 stations deriving their power entirely from fuels and some from hydraulic stations with thermal auxiliary equipment, it is estimated that 98 per cent of all electricity generated for sale is produced by water power. Electric motors contribute 78.6 per cent of the 4,461,867 horsepower utilized by all manufacturing industries in Canada (excluding central electric stations), and 76.3 per cent of the 724,639 horsepower utilized by the mining industry in this Dominion.

Punch press stamping out sheet steel sections for use in the manufacture of electric refrigerators. Labour, equipment and a wide range of materials contribute to the production of electrical appliances.

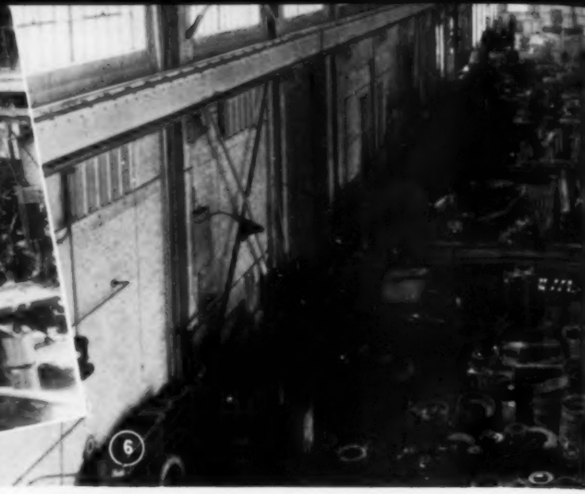
The total output of Canadian stations for the current year is estimated at a new peak figure of 28,000,000,000 kilowatt hours, or more than five times the production in 1919. With a population of 11,080,000, this provides for a per capita consumption of 2527 kilowatt hours. However, it is estimated that the per capita consumption for lighting, cooking, water heating and other household uses is 1,262 kilowatt hours per annum, and due in large measure to the low rates prevailing and the reliable service provided. During 1935, there were 1,401,983 domestic consumers of electricity in this Dominion, or approximately 60 per cent of all families, both urban and rural.

Canada's High National Rating

The table shown below, prepared from figures reproduced in the Statistical Year-Book of the League of Nations for 1937-1938,

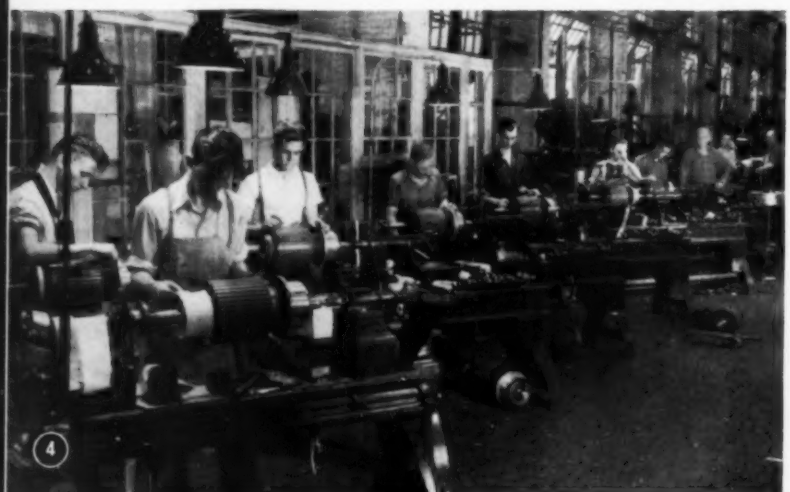
Country	*Population*	*Production (in Kw. hours)*	*Kilowatt Hours per Person*
Norway	2,894,000	7,985,000,000	2759
Canada	11,080,000	27,204,000,000	2455
Switzerland	4,174,000	6,055,000,000	1450
Sweden	6,267,000	7,425,000,000	1184
U.S.A.	128,840,000	113,602,000,000*	881
Germany	67,587,000	42,487,000,000	628
Great Britain	47,187,000	25,925,000,000	551
France	41,910,000	16,300,000,000	388
Japan	70,500,000	24,312,000,000	344
U.S.S.R.	175,500,000	32,800,000,000	186

*Central electric stations only.

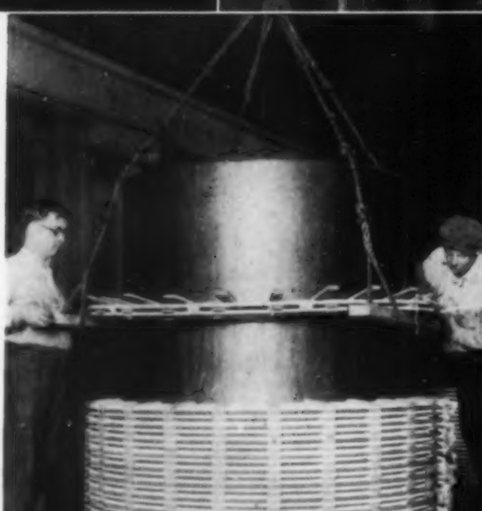


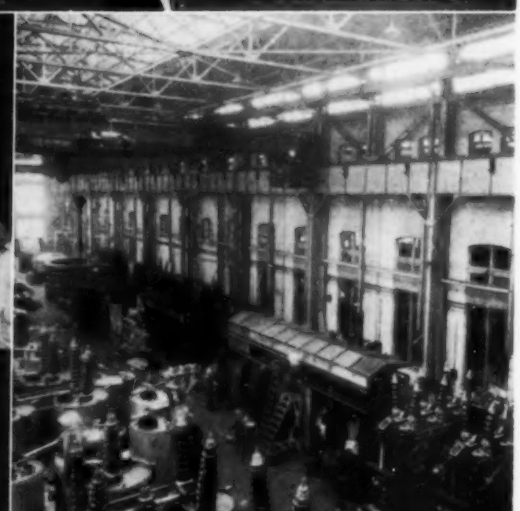
ELECTRICAL EQUIPMENT IN THE

(1) Generator assembly in the main machine shop of the Canadian General Electric Co., Ltd.' at Peterborough, Ont . . . (4) Winding armatures for motors installed in the Toronto Transportation Commission's new high-speed streamlined street cars in the Canadian Westinghouse plant . . . (6) Ma hine shop of the English Electric Company of Canada, Limited, in St. Catharines, Ont.



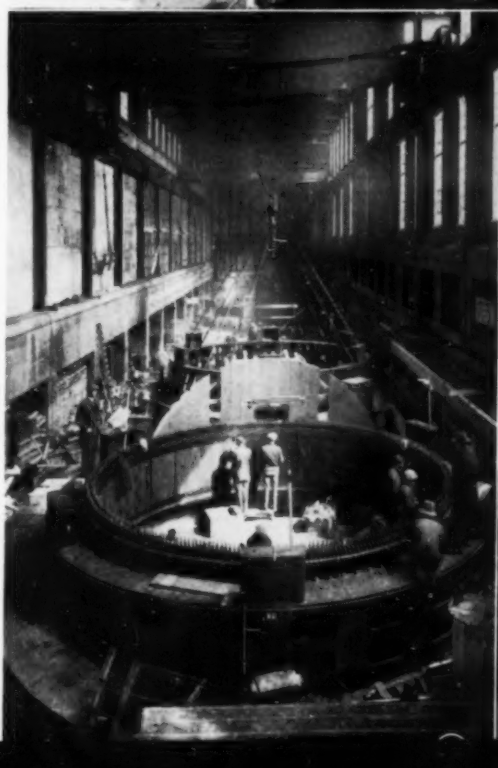
(2) Vulcan, the god of fire, has his modern counterpart in the arc welder, which can join metals together, literally cut through steel and facilitate the fabrication of shapes and structures . . . (3) Assembling disc coils for a General Electric power transformer . . . (5) Circuit breakers being assembled in the Canadian Westinghouse plant. This equipment functions on large power transmission lines and in municipal distribution systems.





FABRICATION AND ASSEMBLY STATE

(7) Wound cores for transformers being assembled and yoke laminations inserted by the Ferranti Electric, Limited, Toronto . . . (9) Almost daylight intensity is secured by the Canadian Westinghouse Company in this manufacturing aisle with special industrial reflectors . . . (10) Manufacture of rubber insulated wire in the Peterborough works of the Canadian General Electric Co., Ltd., (Total production in this country in 1936 had a value of $2,475,155).



(8) Large waterwheel generator building in the Paugan Falls plant of the Gatineau Power Company. A heavy circular steel section of another unit is being lowered into position to the rear. Power generated by this equipment is now being transmitted a distance of 230 miles to Toronto . . . (11) Slag pot for a large mining company being repaired with an electric arc welder.

Province	*Total Power (in H.P.)*	*Motor Capacity (in H.P.)*	*Consumption (in Kw. hours)*
P. E. Island	3,578	703	458,000
Nova Scotia	175,455	106,930	259,409,000
New Brunswick	203,062	153,734	480,073,000
Quebec	1,613,597	1,282,183	9,450,326,000
Ontario	1,734,311	1,415,509	5,254,633,000
Manitoba	130,111	113,512	539,827,000
Saskatchewan	36,116	21,627	64,980,000
Alberta	71,258	46,043	44,337,000
B. C. and Yukon	494,379	365,974	1,602,706,000
	4,461,867	3,506,215	17,696,749,000

indicates the production of electric power by water wheels and thermal engines in eleven of the leading countries of the world during 1936. Although the fourth largest producer of power, Canada is surpassed only by the U.S.A. in the hydro-electric field, fuel being used extensively in Germany and Russia for the generation of power. Even in the United States, only 36 per cent was derived from water wheels.

The table shown above is of interest, indicating as it does the total power employed, the total electric motor capacity and the total consumption of electricity in the manufacturing industries for the nine provinces of the Dominion during 1936.

Some conception of the market potentialities for electrical apparatus and supplies is indicated in an interesting survey undertaken last year by the Hydro Electric Power Commission of Ontario in municipalities and rural power districts. A material increase in the number of electrical applicances employed was noted, and also in the saturation percentages. Farm customers are displaying particular appreciation of the advantages to be derived from the utilization of electricity, and an increase of 8,600 consumers in this class was recorded for the twelve-month period. Of rural homes provided with power, 75.31 per cent had electric irons, 68.52 per cent had electric radios and 57.54 per cent were equipped with washing machines. The table reproduced below provides an interesting comparison between the urban and rural homes, indicating the percentage of saturation.

Natural gas and the establishment of municipal gas plants curtails the use of electric ranges, while the absence of any system for the provision of a regular flow of water in many rural areas limits the installation of heaters. Nevertheless, it is maintained that the saturation point for electrical equipment is still distant in the Province of Ontario, and the same situation is applicable in other sections of the Dominion. While the engineer is still concentrating on problems of generation, transmission and distribution of power, the manufacturer is enabled to secure a wider sale for his product through the creation of confidence between public utilities and householders. In order that Canadians may benefit to the fullest extent from the vast water power resources at their disposal, it is maintained that constant efforts be made to create a clearer conception of the facilities available and the advantages to be derived from the installation of electrical equipment in the home.

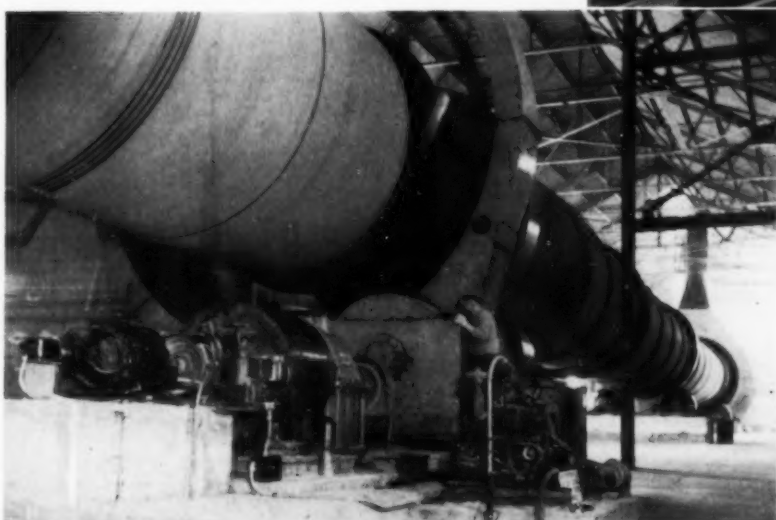
This mighty force has transformed the world of matter into a great nerve, vibrating thousands of miles in a breathless point of time. It might well be the brain whose slightest impulse drives the wheels of creation. Man has harnessed this power, and holds the reins, though nature wields the whip, and the horses await the increasing demands of struggling humanity.

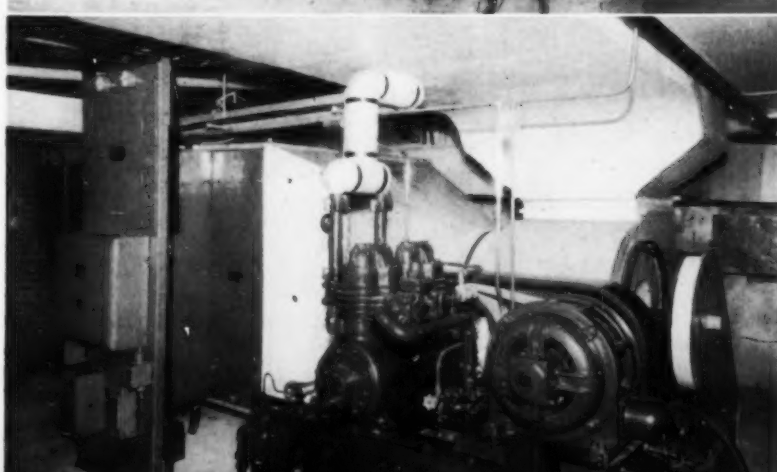
Electric Appliance	*Number—Urban*	*—Saturation*	*Number—Rural*	*—Saturation*
Range	141,581	28.6	6,462	16.97
Hot Plate	83,521	16.9	8,300	21.80
Washers	224,992	45.5	21,909	57.54
Vacuum cleaners	151,448	30.6	4,859	12.76
Water heater (flat rate)	47,151	9.5	1,281	3.36
Water heater (metered)	44,745	9.1	637	1.67
Grate	36,289	7.3	288	.75
Air heater	146,313	29.6	3,748	9.84
Ironers	11,315	2.3	459	1.21
Irons	469,045	94.9	28,672	75.31
Refrigerators	76,974	15.6	3,786	9.94
Toasters	282,294	57.1	19,941	52.37
Radios	356,761	72.2	26,090	68.52
Furnace blower	23,371	4.7	540	1.42

TOP—Lowering a wound stator into an impregnating tank in the plant of the Commonwealth Electric Corporation, Ltd.

CENTRE—Variable speed motor driving the largest cement kiln in the world — 450 feet long and 11 feet in diameter — of the Canada Cement Co., at Belleville, Ont.

BOTTOM—Air conditioning equipment provided by the Canadian General Electric Co., Ltd., for the offices in Montreal of the Ogilvie Flour Mills, Ltd.

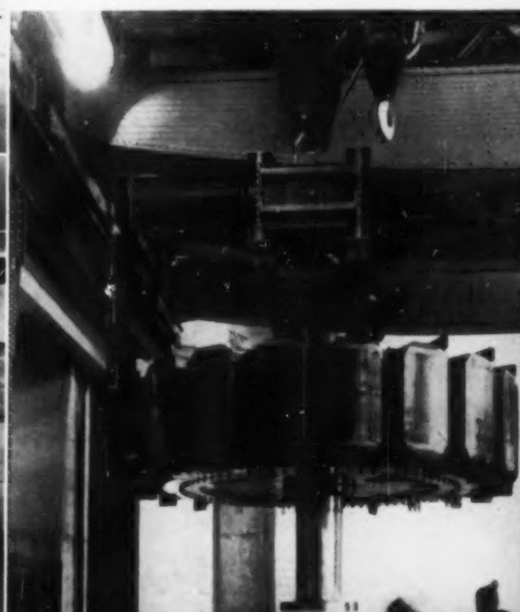


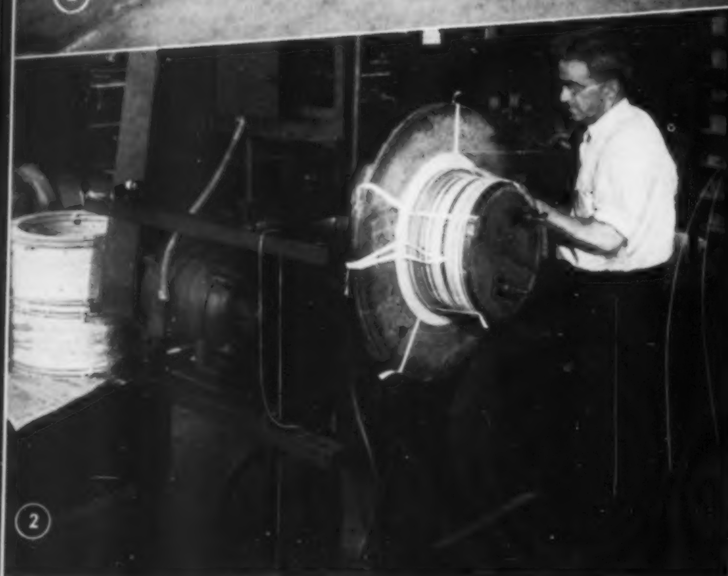


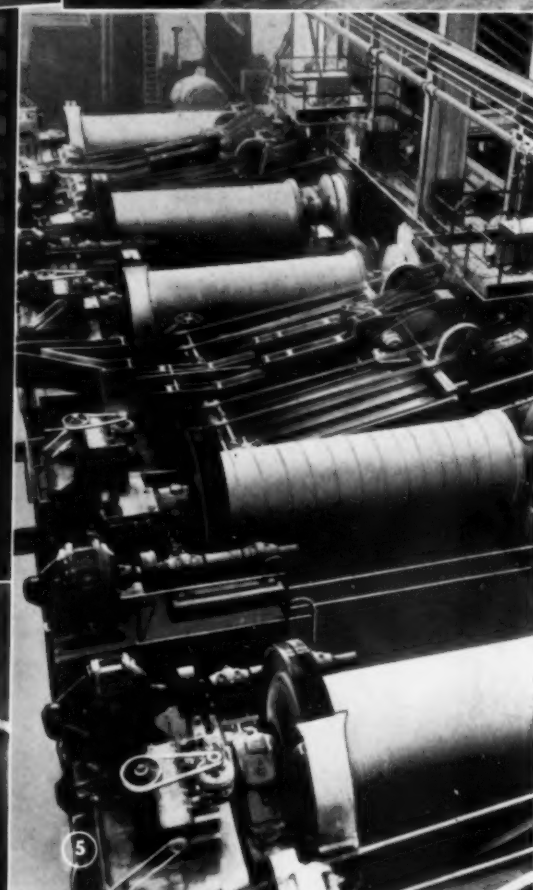
TOP—Canadian General Electric 46,625 k.v.a. vertical waterwheel-driven generators in the Beauharnois Light, Heat and Power Company's plant.

CENTRE—Electric vitreous enamelling furnace in service in the Toronto factory of the General Steel Wares, Ltd.

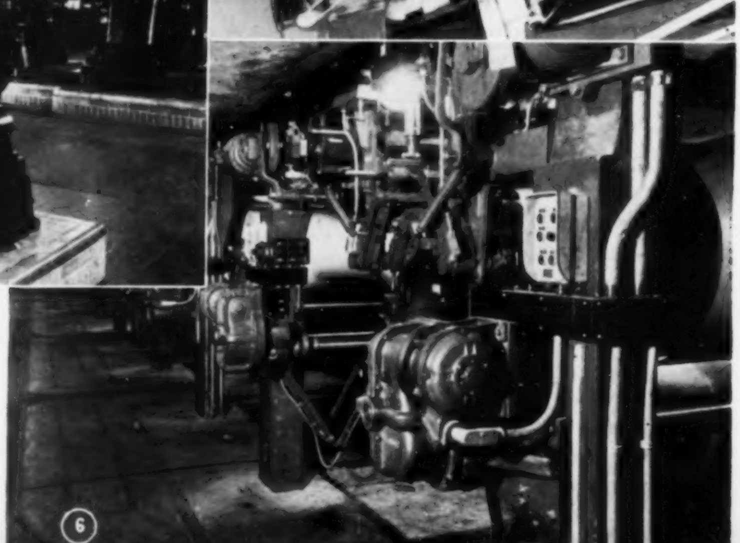
BOTTOM—Rotor of G. E. 48,500 k.v.a. vertical waterwheel generator being lifted with special device in the Abitibi Canyon Development of the H.E.P.C. of Ontario.

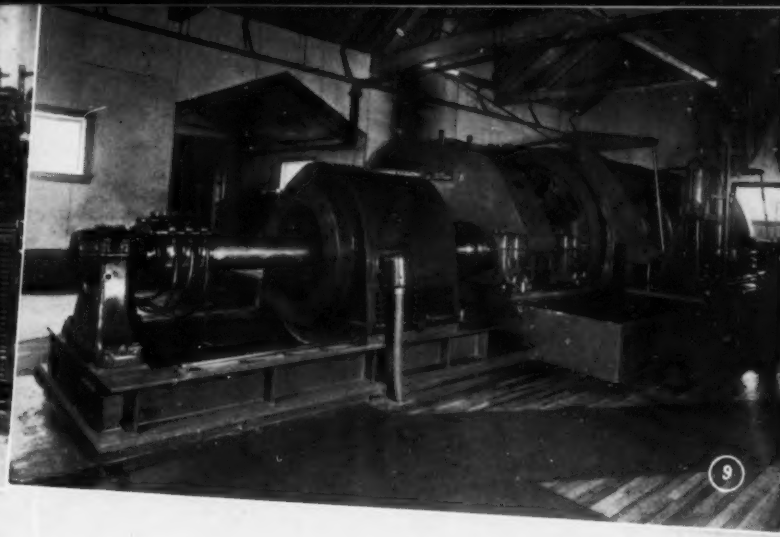


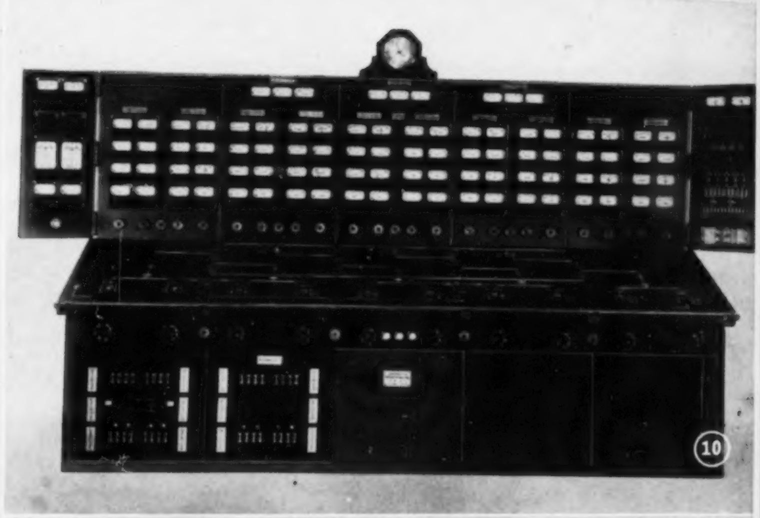


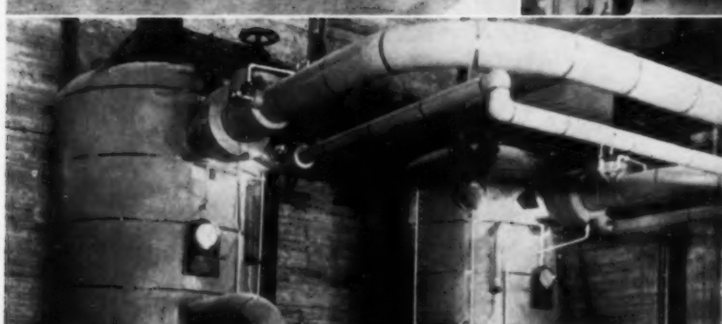


(1) Six 2,560 k.v.a. synchronous motors driving pulp grinders . . . (2) Winding transformer cores . . . (3) Two 740 k.v.a. synchronous motors driving centrifugal pumps in Ottawa's filtration plant . . . (4) Textile mills, with hundreds of motors driving their looms, and adequate illumination are dependent on electricity . . . (5) Five 150 h.p. induction motors drive tube mills in a gold mine . . . (6) Newspaper rotary presses are controlled by the touch of an electric button.









(7) Gates weighing 500 tons on the Welland Ship Canal may be lifted by this boat through the operation of electric pumps that transfer water ballast . . . (8) Two 10,000 k.w. electric steam generators in a paper mill . . . (9) Motor of 600 h.p. operating ore hoist in an Ontario gold mine . . . (10) Control desk at Chats Falls power station. The indicating instruments convey to the operator the condition of all equipment at any moment . . . (11) Eighteen 3,600 k.w. converters in the Arvida plant of the Aluminum Co. of Canada.

The Tithe Barns of England

by **J. D. U. WARD**

A full century has now elapsed since the Tithe Commutation Act of 1836 was passed by the British Parliament; and the year 1936 saw both a new Tithe Rent Charge Act placed upon the Statute Book and more violent disputes about the payment of tithe by English farmers. But bitterness and strife is not the whole of the legacy left by tithe. There are also the great tithe barns, which still dignify the countryside with their serene and noble beauty.

These buildings, intended to house tithes paid in kind before the commutation of tithe for money, may be seen in many towns and villages in England, especially in the southwest.

The tithe or tenth part of produce, which had to be rendered to the local ecclesiastical authorities, was levied on cattle, wool, milk, corn, roots and grass, and hay crops. In short, nearly all agricultural products—but not minerals — were subject to tithe. Pigeons or doves, which were largely kept to provide winter food until new discoveries in the eighteenth century enabled farmers to maintain an adequate head of farm stock in fair fettle (fit for butchering) throughout the lean months, were treated thus: "No Tythe is due for Pidgeons consumed in a Man's House, but if kept in a Dove-house they are tythable."[1] Prebendary John Nutt, writing in the year 1622, notes:[2]

> The piggeon house has paied mee tithes and doth this yeare by Nicholas Dobson now farmer thereof; it is rented at £5 a yeere but I take them in kinde and stand to the truthe and conscience of the farmer in the paying of them.

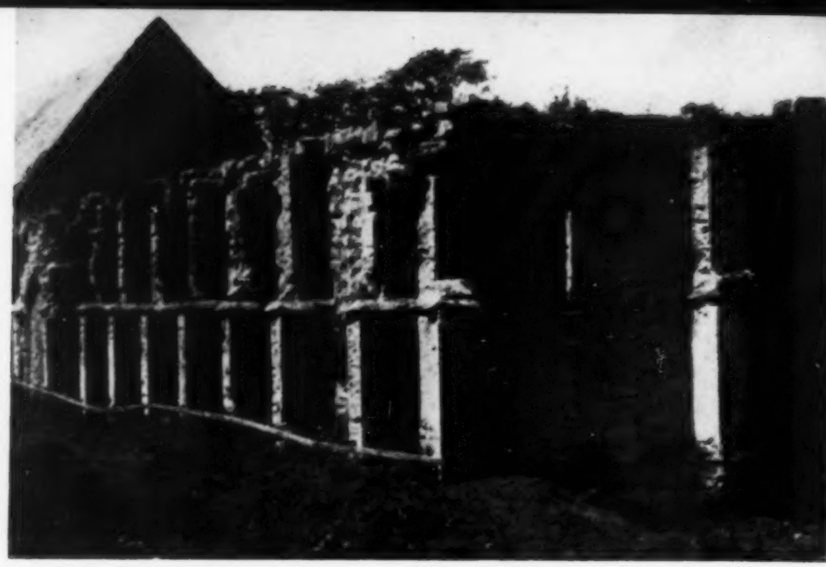
Of course, wherever pigeons were bred in large numbers, they were kept in dove-houses. In some places; for example, Hurley in Berkshire and Patcham in Sussex, an ancient dove-house may be seen standing near the tithe barn itself. Incidentally, it has been questioned whether the Patcham barn (close to the church) is a tithe barn. It appears, however, to have been built originally for the storage of grain, though it is now a cowshed, with 96 stalls. One thousand pounds is said to have been offered and refused for the oak beams of this building.[3]

Probably there was of old a tithe barn in most parishes. It is only the best which still stand. This no doubt explains the survival of far more grand old barns of stone than of any other material. Some of the veterans are truly magnificent in their proportions, and quite fit to be compared with abbeys. Indeed, the great porches, built high to admit the largest waggons when fully loaded, have something of the appearance of transepts, and a few of the finest barns boast decorated stonework and niches intended for sculptured figures of the saints. The barns at Abbottsbury and Glastonbury may be instanced.

The size and, to a less extent, the embellishment of the tithe barn can sometimes be taken as a rough measure of the former wealth of the parish and the strength of the religious community resident in it. The very fine and carefully restored barn at Cerne Abbas may be mentioned. This lovely building is, however, a modest 130 feet in length, whereas Abbotsbury barn is 282 feet long. But half of the latter building is now roofless and in ruins. Harmondsworth (Hermondesworde of Domesday) is 191 feet long and is believed to be the longest timber barn in England. This 14th century barn is, apart from its size, very disappointing from outside, despite a lovely setting of walnut trees, but within it is truly noble. The beautiful open timbered roof is supported by two rows of massive columns. Incidentally, visitors who go to see it after harvest will probably be disappointed, for then it is liable to be stacked to the roof with sheaves.

There is a very fine stone barn at Tisbury in Wiltshire. This example measures 188 feet in length. A less famous example may be seen at Preston Plucknett, nearby. The tithe barn at Frocester in Gloucestershire is 184 feet long. Bradford-on-Avon has a magnificently proportioned tithe barn, sometimes stated to be the finest barn in England despite its comparatively modest length of 167 feet. This building is now used as a museum by

LEFT:—Great Coxwell Tithe Barn, near Farringdon, Berkshire.



ABOVE:
Abbottsbury Tithe Barn
(sound end with thatched roof)

UPPER RIGHT:
Abbottsbury Tithe Barn
(ruined end)

ABOVE:
Hartpury Tithe Barn, in Gloucestershire

LEFT:
Sturry Tithe Barn, near Canterbury

UPPER LEFT:
Great Coxwell Tithe Barn, Berkshire

ABOVE:
The Great Barn, Harmondsworth, Middlesex

ABOVE:
Ashleworth Tithe Barn, in Gloucestershire

RIGHT:
Interior of Barton Tithe Barn, Bradford-on-Avon, Wiltshire

the Wiltshire Archaeological Society, and a charge of 3d. is made for admission. Other good Wiltshire barns may be seen at Lacock (two) and Cherhill.

In Gloucestershire there are three tithe barns so close together that they may all be visited in an afternoon's walk; these being at Ashleworth, Hartpury and Highleadon. There seems to be some doubt as to whether the comparatively insignificant barn at Highleadon has indeed ever been a tithe barn in its truest sense, but it is certainly very interesting for the variety of building materials—stone, brick and timber—which were used in its construction. The roof is also variegated, but a big patch of corrugated iron adds neither to the beauty nor the interest of the rest.

In the grounds of Milner Court Preparatory School, Sturry, near Canterbury, there is an interesting timber tithe barn with a tiled roof. (Most surviving tithe barns have stone roofs but a fair number are tiled; and those at Abbottsbury and Tisbury, with two or three other examples, are thatched). Another Kentish barn—an unusually early one, probably dating from the 13th century—has been moved from Birchington to New Barnet in Hertfordshire, where it has been converted into the chapel of the community, which is known for its work in founding and maintaining the Abbey Folk Park and Museum. Perhaps the finest of all Kentish barns is the one at Maidstone, which has a most interesting covered staircase outside the barn itself.

Stairways or steps are not very commonly seen on tithe barns, though they were of course often built up to farm lofts. Most of the tithe barns which have steps are stone barns, built in stone districts, but there are steps at one end of the flint tithe barn at Alceston, in Sussex, and the barn at Bredon, in Worcestershire, also boasts steps.

The barn at West Blatchington, in Sussex, has a feature which is probably unique. This is a windmill, incorporated with the barn, from and above whose roof it springs. To have the mill so near the stored corn was an obvious convenience, but one imagines some tithe was lost through this device, for it was ordained that "All Corn-Mills, not erected before Stat. 9 Ed. 2. are tythable; but if before the Memory of Man, the law presumes them to be before the Statute; yet if one pays Tythe for his corn, and after grinds the same at a Mill in the same Parish, no Tythe is to be paid for the Meal."[5]

Some idea of the various uses to which tithe barns have been converted has already been given, but it may be added that other barns have been turned into private dwelling houses, music rooms, theatres and libraries, and one barn (now no more) once had a miniature rifle range within it. Most surviving barns, however, are still used in connection with agriculture, and permission to look over them may be obtained by asking civilly at the nearest farmhouse. It is unfortunate that many should now suffer from accretions such as pigsties, calf houses and bull yards, which are built on to them, but this is better than that the barns should be entirely neglected and fall into ruins.

Anything like a complete catalogue of tithe barns would take a long time to compile and much space to print, but to the barns already mentioned the interesting examples at the following places may be added: Dartington, in Devon; Selworthy, Doulton and Wells, in Somerset; Great Coxwell, near Farringdon, in Berkshire; Beaulieu, in Hampshire; North Lancing and Exceat, in Sussex (the barn at the latter place has a herringbone brickwork floor and there is a dovecote near); Tonbridge, in Kent; Ruislip, in Middlessex (two); the Easton Lodge Estate, in Essex; Easington, in Yorkshire (a thatched barn, now a museum); and Middle Littleton, in Worcestershire.

Many very fine tithe barns have passed from the face of the land. A magnificent early example, known to have been built in 1306, was destroyed at Peterborough just forty years ago. It is devoutly to be hoped, however, that surviving barns, though no longer required for their original purpose of storing tithes, will, wherever possible, be maintained in proper repair for the sake of their beauty—both within and without—which should stand as an example to those modern builders who love to use materials and designs which are foreign to the countryside of old England.

1—"The Compleat Tythes Man," published in the 18th century and containing many interesting details.
2—"Remembrances for the Parsons of Berwick."
3—Stated to be 320 feet long: not verified.
4—See footnote 3, Supra.
5—"The Compleat Tythes Man."

Barton Tithe Barn, Bradford-on-Avon, Wiltshire

The Abbot's Barn, Glastonbury

EDITOR'S NOTE BOOK

Mr. Bradford Washburn, whose address last April to the Canadian Geographical Society on his "Conquest of Mount Lucania" is summarized in this issue, is an explorer of note and instructor at the Institute of Geographical Exploration at Harvard University. Though only 27 years of age, he has spent four seasons in the Alps and participated in eight Alaskan expeditions. He addressed the Society in March, 1936, on the subject of his mountaineering experiences the previous year in the St. Elias Range, which extends through the southwestern section of the Yukon and Alaska.

Mr. Washburn has accepted tentatively an invitation to speak to members of the Society about his activities last summer, when he claims to have discovered the largest glacier system in the world outside the polar ice caps. During a six-hour flight in August, it was learned that the combined glacier system of the St. Elias Range was a mammoth expanse of unbroken ice, several thousand feet deep and stretching almost from Cape St. Elias southward and eastward for 235 miles to the Alsek River valley. A complete photographical record of the glacier discovery was made.

Caption for photograph on Page 179 (top) should read — Mount Blackburn (16,140 feet), second highest peak in the Wrangell Range, towers above the dirt-covered Kuskulana Glacier.

Mr. J. Fergus Grant, whose survey of "Canada's Electrical Manufacturing Industry" is reproduced in this issue, is Quebec representative of the Canadian Geographical Society and a journalist of wide experience. In compiling information for this article of an economic geographical character, he received material assistance from Mr. John A. M. Galilee, of the Canadian Westinghouse Company, Limited Mr. John Murphy, F.A.I.E.E., M.E.I.C., of Ottawa; officials of the Dominion Bureau of Statistics, engineering experts of the National Research Council, the Canadian General Electric Company, Limited, the Hydro Electric Power Commission of Ontario, and the Northern Electric Company, Limited. Appreciation is also expressed to the following firms for additional facts and photographs: Amalgamated Electric Corporation, Limited; Canadian Line Materials, Limited; Canadian Marconi Company; Commonwealth Electric Corporation, Limited; English Electric Company of Canada, Limited; Ferranti Electric, Limited; Lincoln Electric Company of Canada, Limited; Moloney Electric Company of Canada, Limited; Packard Electric Company, Limited; Sagamo Company, Limited; and the Square D Company of Canada, Limited. Included in the bibliography are the Proceedings of the International Bureau of Weights and Measures, 1937 session; and the Statistical Year-Book of the League of Nations.

Announcement -- Christmas Club

The Editorial Committee of the Canadian Geographical Journal is pleased to announce to its readers that the Christmas (December) issue will contain two feature articles of particular interest to Canadians and appropriate for Christmas gifts to friends at home and abroad. Sir Robert Falconer contributes an arresting and illuminating article entitled "Canadian Universities"; extensively illustrated. Mr. D. W. Buchanan writes on "Canadian Paintings", which will be illustrated with reproductions from works of Canadian artists in an extended *four-colour* section.

NEW "EMPIRE" FLYING BOATS

Eight new flying boats, "modified" versions of the Caledonia and Cambria that flew to Canada last year, are rapidly being prepared for service. "Champion", first of the new fleet, was ready for launching the end of last month, and "Cabot" will follow her into the water in the near future. The latter may possibly cross the Atlantic this autumn.

Seven of these new boats have been strengthened to take increased loads of 53,000 pounds, as compared with a maximum weight of 40,500 pounds for the standard Empire boats now in operation. "Champion" is equipped with four Bristol Pegasus engines, each of which develops 920 h.p. for take-off, and has a top weight of 46,000 pounds. "Cabot" and her successors will be fitted with four Bristol Perseus sleeve-valve engines developing 890 h.p. at 7,000 feet. With the exception of "Champion", these craft are equipped with mechanism that enables them to refuel in mid-air from a "tanker" aeroplane.

Taking off with a load of 45,000 pounds, the new flying boats will rise to such a height as to permit of another aircraft safely coming alongside to pump in fuel that will bring the total weight of the machine to its maximum of 53,000 pounds. This will greatly increase the payload for a long transoceanic or other non-stop flight.

FROM THE UNKNOWN...
to the familiar

What was declared impossible fifty years ago is now an accomplished fact. Production of the first commercial alternating current transformer by Westinghouse opened the way to the tremendous electrical development which followed. Since then Westinghouse research has given to the world a steady stream of electrical blessings.

Today huge Westinghouse generators enable central stations to produce electrical power . . . Westinghouse transformers and circuit breakers assist its distribution . . . Westinghouse motors apply this power to the service of industry whilst Westinghouse Ranges, Refrigerators, Washers, Radios and Mazda Lamps bring comfort and relief from toil to homes throughout the land. For Reliability in Everything Electrical, specify Westinghouse.

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CANADIAN WESTINGHOUSE

RADIO-CONTROLLED AIRCRAFT

Illustrating the extensive application of electricity, other phases of which are discussed in this issue, warships of the "Home" Fleet in Scottish waters have recently engaged in an extensive programme of gunnery practices, employing as targets "robot" or pilotless aircraft. Launched by catapult and radio-controlled during flight by an observer in the safety zone, "Queen Bee" aircraft enable naval gunners to undertake realistic gunfire practice under peace conditions and without danger to personnel.

Contrary to popular belief, fire is not invariably directed at these robot 'planes in flight. Cost of the machines and the delays occasioned through awaiting replacements if destroyed constitute the principal objections to seeking a direct hit. Provided the gunners are able to "straddle" the target, securing shell bursts on either side of the target, the object of the exercise is fulfilled.

These aircraft, which resemble the Tiger Moth trainer now being built in Canada, is a biplane with two cockpits. One is open and can be occupied when necessary by a human pilot, while the other is enclosed and contains the secret mechanism that makes the machine responsive to the control of a remote operator. The approximate range of radio control is ten miles.